Southwestern Water Markets as Indicators of Value

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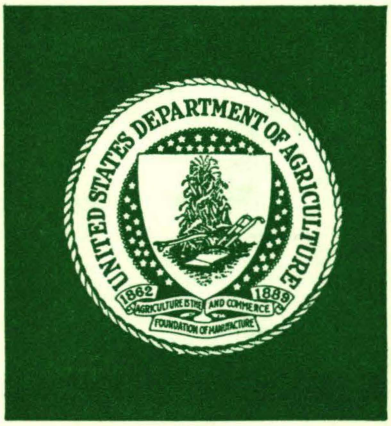

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Southwestern Water Markets as Indicators of Value

Final Report to the U.S. Forest Service,
Rocky Mountain Station

Contract No. 28-G4-336

B. Colby Saliba, Principal Investigator
William E. Martin, Principal Investigator
David Bush, Research Associate

Department of Agricultural Economics
College of Agriculture
University of Arizona
Tucson, Arizona 85721

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The authors acknowledge the helpful input of Tom Brown, economist with the Forest Service, and appreciate the information on local water market activities provided by knowledgeable individuals in the regions studied. Statements in this report on the legal status of water rights and market activities are accurate to the best of the authors knowledge. However, such statements are not intended as legal advice and appropriate state officials and attorneys should be consulted for authoritative legal information.

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EXECUTIVE SUMMARY

Valuation of incremental changes in water availability is an important issue in the western United States as agriculture, industry, energy development, and population growth exert increasing pressure on limited water resources. Water yields can be significantly altered by management practices on public lands, raising questions regarding the value to society of these potential increments or decrements. Strong pressures for water markets exist as water in many regions is fully appropriated and new uses can be accommodated only through transfer from established uses. In some areas, market activity has been occurring for several decades. In other areas, institutions which govern water allocation are only slowly becoming conducive to market transfer of water rights. This research analyzes selected water markets in the western United States, measures water prices over time in these markets, and evaluates the appropriateness of using these market prices as measures of the economic value of incremental increases in water yield from public lands.

Equity issues, external effects of market activity, imperfect competition, and legal, economic and hydrologic uncertainty are identified as market characteristics which may distort prices as indicators of water values. Western water markets exhibit these characteristics to varying degrees and the appropriateness of using a particular set of prices must be evaluated on a case-by-case basis, based on a thorough understanding of market activities and price formation processes. Even if there are no conceptual reasons to question whether observed prices are appropriate measures of value, a number of practical problems would confront an agency desiring to use market prices. Prices are rarely a matter of public record

and price data must be solicited from market participants. Several types of water commodities are found in each of the regions studied, and it must be determined which, if any of them, approximate the conditions under which augmented yields will be made available.

Market prices will not usually provide an effortless and straight forward measure of value and should be used as one of several sources of information on water values incorporated into valuation procedures. Under most circumstances, non-market valuation techniques would be helpful in supplementing price data generated by market transactions. Use of both market and non-market information is recommended to ensure that public agencies seeking to value increased water yields from public lands use measures that approximate willingness to pay for that water as closely as possible.

TABLE OF CONTENTS

Executive Summary **Page**

I. Introduction

Research Objectives 1
Organization of Final Report 1
General Characteristics of Southwestern Water Markets 2
Criteria for Selection of Study Areas 6
Overview of Field Research Activities 8

II. Market Description and Comparison

Arizona 11
Colorado 31
Nevada 69
New Mexico 90
Utah 106
California 124

III. Market Prices as Measures of Value

Conceptual Limitations 136
Market Characteristics 139
Comparison of Market Characteristics and Implications 143
Practical Considerations in Using Market Prices 149
Appropriateness and Ease of Using Prices 151
Other Indicators of Water Values 153

IV. Summary and Implications 156

References 159

Appendices

A: Water Rights in Southern Arizona 167
B: Water Rights in Northeastern and Southeastern Colorado 172
C: Water Rights in the Truckee and Carson River Basins of Nevada 177
D: Water Rights in the Gila-San Francisco Basin of New Mexico 181
E: Water Rights in the Delta and Lynndyl Areas of Utah 183
F: Summary of Market Price Data 185
Arizona
Colorado
Nevada
New Mexico
Utah

LIST OF FIGURES

		PAGE
Figure 1:	Water Market Study Areas	7
Figure 2:	Water Demand and Supply	137

LIST OF TABLES

Table 1:	Market Characteristics, Definitions and Examples	142
Table 2:	Prices for Avra valley Farmland, Arizona	186
Table 3:	Pinal County Farmland Purchases, Arizona	188
Table 4:	Type II Non-Irrigation Rights Prices, Arizona	189
Table 5:	Planet Ranch Purchase, Arizona	190
Table 6:	Sales of Twin Lakes Water Stock, Colorado	191
Table 7:	Rentals of Twin Lakes Water	192
Table 8:	Sales and Leases of Other Southeastern Colorado water	193
Table 9:	Representative Prices in Northeastern Colorado	194
Table 10:	Selected Rental Prices in Northeastern Colorado	195
Table 11:	Sierra Pacific Acquisitions of Truckee River Rights	198
Table 12:	Other Acquisitions of Truckee River Rights	199
Table 13:	Groundwater Rights in the Truckee Basin	200
Table 14:	Water Rigths Sales, Gila Sub-basin of New Mexico	201
Table 15:	Water Rights Sales, San Francisco Sub-basin of New Mexico	203
Table 16:	Water Rights rentals in Gila-San Francisco Basin	204
Table 17:	Sales of Groundwater Rights, Delta Area	205
Table 18:	Rental of Delta Co. Water	206
Table 19:	Sales of DMAD Co. Stock	207

INTRODUCTION

Research Objectives

This research has six major objectives as outlined in the Technical Proposal submitted to the Forest Service in June of 1984. They are as follows:

1. Describe and compare the legal institutions relevant to exchange of water in Colorado, Utah, New Mexico, Arizona, Nevada, and southern California.

2. Identify and describe water rental and rights markets in the study area.

3. Analyze and compare the identified markets in terms of historical development, supply and demand, structure, and the competitiveness of the price determination process.

4. Compile data, where available, on water prices over time in the identified markets.

5. Evaluate the appropriateness of using these market prices as measures of the economic value of incremental water flows.

6. Summarize the implications of the study for valuation of altered water flows from public lands.

Organization of Final Report

Description, analysis and comparison of identified water markets for objectives 1-4 is reported in the next section of this document. Information on water markets in California is speculative and unverifiable due to a lack of readily observable market activity. Therefore California was eliminated from the study, with the exception of a description of California water laws and institutions as they define and limit market activity. Price data is also reported for each market in the second section, "Market Descriptions".

Section III, "Market Prices as Measures of Value" discusses both theoretical and practical considerations that affect the appropriateness

and usefullness of observed prices as measures of value for use by a public agency. Prices generated by the specific water markets investigated in this study are evaluated in this section.

The Summary and Conclusions section provides a summary of the project's major findings and their implications for valuing incremental water yields from public lands. Recommendations on use of market prices by public agencies are provided, along with suggestions for future research efforts complementary to the objectives and results of this study.

Appendices A through E summarize the various types of water rights in the states studied. Appendix F summarizes price data collected in each state.

General Characteristics of Southwestern Water Markets

A water market may be defined as any institutional setting within which water, or the right to use water, is either explicitly or implicitly bought, sold, rented, exchanged, or traded among consenting parties. The concept of water marketing is contemporary of interest in the arid and semi-arid regions of the southwestern United Sates. Several common characteristics serve to distinguish water and water institutions in the Southwest from other regions in the United States, Water use in the Southwest has been dominated by irrigated agriculture. Early settlement and economic development were founded on the creation of of primary industries such as mining, ranching, and agriculture. Today irrigated agriculture represents only a minor portion of the income generated in most southwestern economies. Yet this sector is still the predominant user of water throughout the region.

Irrigated agriculture (and, to a lesser extent, mining) created a large demand for water that the seasonal and unpredictable surface water

resources of the Southwest could not fully satisfy. Acting first on an individual basis and then collectively, water users built ingenious systems to capture, store, and transport water to bring it to where it was in demand, at the proper time and in desired amounts.

Unlike water use in more humid regions, the location of water use in the Southwest often has little relation to the point of diversion and storage. Typically water diverted and stored at only a few strategic locations along a stream system may support a network of users located miles away from the source.

Separation between the point of diversion and waters' place of use grew even wider when, early in the 20th century, state and federal governments began the construction of ambitious land and water reclamation programs. Water began to be transported from farther and farther afield as "native" sources of water were fully developed. Elaborate systems of pipes, pumps, reservoirs, and canals permitted the transportation of tens or even hundreds of thousands of acre feet of water per year across mountain ranges and entire hydrologic basins to areas of growing water demand.

An increasing level of competition for limited water resources led to bitter conflicts among competing water users. Coincident with the physical development of water infrastructure, laws and institutions evolved to address issues of ownership, access, and distribution of water rights peculiar to the Southwest. English common law and riparian systems of water rights ownership, predicated on an intimate association between water resources and the land from which they originated, were poorly suited to the special conditions of water resources development and use in the West. The uniquely American legal doctrine of "prior appropriation" developed to

meet the need for a new system of apportioning water resources in arid areas, where the point of diversion and place of use of water resources might be separated by considerable distances.

The southwestern states experienced rapid rates of population and economic growth following the end of the Second World War, a phenomenon that is continuing. Concurrent with this growth there has been a dramatic structural change in regional economies. While irrigated agriculture remains the predominant water user region-wide, the nonagricultural sectors of the economy now employ all but a fraction of the work force and earn the great bulk of all income. The construction, manufacturing, service, and government sectors of the economy are competing for the land and water resources once devoted exclusively to agriculture.

Historically, water supplies in the Southwest have beenexpanded to satisfy demand. Incentives to transfer water resources from an existing user to a new user were low so long as new water resources were relatively cheap and easy to develop. It has become increasingly evident, however, that the era of cheap new sources of water has come to an end. Water projects developed over the past few decades have cost hundreds of millions to several billion dollars each, and in most cases the cost of building these project has been heavily subsidized. High costs for new water projects have severely undercut their support in the government and led to lengthy delays in their authorization, funding and construction. The future for additional projects seems to be no brighter.

Even as fewer new water supply projects are planned, demand for water continues to threaten to outstrip supplies. Competition among existing and new users for limited water resources is entering a new and decisive phase in the Southwest, where new uses for water resources will come largely at the expense of diverting water from older uses.

Growing demand and limited supplies for water are generating pressure to reallocate water resources from lower to higher economic uses. Attitudes regarding water and water rights, which have sometimes been considered too precious and "different" to expose to the viscitudes of the competitive market, are slowly changing. Water is in transition from a traditionally free or at least very cheap good to an increasingly scarce and expensive commodity, available first to those who are willing to pay the most for it.

Reallocation, however has rarely been simple to accomplish. The hydrologic complexities of water oftentimes make it difficult to transfer water from one use and user to another without impacting other users. Southwestern water laws and institutions, which have traditionally served to protect and the water rights of existing users and resolve conflicts, are frequently ill-equipped to handle the challenges of changing a economic environment. Pressures are growing throughout the Southwest to alter water laws and institutions to adjust to the emerging economic conditions of continuous water scarcity. Antiquated institutions which lock water use into its historic patterns are slowly giving way to new systems allowing a greater degree of flexibility.

The construction of extensive physical insfrastructures to capture, store, and deliver water, rapid rates of economic growth and changes , the rising cost of developing new water supplies, and the pressure to adapt water institutions to socio-economic change in the face of growing water scarcity. have all led to the continuing development of southwestern water markets. In some areas of the southwestern United States, market activity in water has been occurring for some time. In other areas, institutions are only now slowly adapting themselves to the pressures of change. The

following sections of this report examine the structure and behavior of specific southwestern water markets.

Criteria for Selection of Study Areas

The general study area for the project covers the arid and semi-arid regions of the southwestern United States. This includes the states of Arizona, Colorado, Nevada, New Mexico, Utah, and the southern half of California. Within each state one or two "market areas" were identified for in-depth study. These areas are identified on Figure 1. There were four basic criteria employed in selecting the market areas.

Each area needed to have defined geographical boundaries. A survey of existing literature and preliminary field investigations appeared to indicate that most water markets exist within relatively closed systems-though few water markets are absolutely closed to the transfer of water into or out of their areas. Significant inter-basin transfers of water, such as the movement of water from northern California to southern California, or from the west slope of the continental divide in Colorado to the east slope, have usually been freely appropriated rights without market transactions.

Each market had to be characterized by economic scarcity of water resources. It is in fact scarcity that stimulates market formation. If water were available to meet all potential demand at the prevailing costs of obtaining the water there would be no incentive for market activity. For example, nearly one-third of the state of New Mexico is still open to appropriation of local water supplies. It is in the adjudicated basins, closed to new appropriations, that markets have formed. The scarcity criteria did not limit the study to areas in which absolutely no additional

1 Phoenix and Tucson Active Management Areas
2 Northeastern Colorado Arkansas River Basin
3 Southeastern Colorado Platte River Basin
4 Truckee River Basin
5 Gila-San Francisco Basin
6 Lower Sevier River Basin

Figure 1. Water Market Study Areas

water resources could be appropriated. In the strictest sense, every market area investigated still remains open to either appropriation or to the importation of new water. However, in each of these markets the supply of new water resources available for appropriation is inadequate for most uses and users. "Free" water rights are generally either 1) too restricted in quantity or usefulness to provide an acceptable alternative to purchasing existing water rights, 2) legally difficult or even impossible for many user classes to access, or 3) prohibitively expensive to develop.

Reasonably active markets with some history of water transfers continuing up to the present time were selected. Locations with low levels of activity were of less interest because of lack of price data. Locations with sporadic or historic market activity also were rejected because there were no opportunities to observe price trends. The observation of both changes in market structure and price levels over time is an important means of evaluating the competitiveness of market processes.

Finally, it was important that enough information on the selected markets be available within the time and budget limitations of the project. Some potential market areas were rejected because the available records on market transactions were too disperse, too difficult to obtain, and/or too poorly maintained to provide meaningful information.

Overview of Field Research Activities

Every water market area ultimately chosen for study was unique and contrasted sharply with every other water market area. Each exhibited its own particular idiosynchysies and presented its own special challenges and puzzles. Although there was no particular chronological order in the

sequence of field investigations carried out for each market, the same basic five steps were followed.

The first basic step was to describe the physical, institutional, and economic characteristics of the market area. Some markets trade primarily in groundwater rights, others primarily surface water rights, and some trade in both. Some water resources are managed in large, sophisticated and highly integrated systems, and in other areas the facilities for storing and distributing water consist mostly of small, unconnected private works. Some markets are managed by centralized state or federal agencies, while other markets are controlled locally. Some markets are very large and complex with many individual actors. Other markets are relatively small and dominated by only a small group of important buyers and sellers.

The next step was to describe the laws and institutions which defined water rights tenure and transfer. This portion of the study quickly assumed a critical degree of importance in comparing the water markets. Different areas with similar economies and hydrologic characteristics have strikingly different market environments and marketable water commodities, simply because of the way that the laws and institutions treated water rights. It is as much, if not more, the nature of the laws and the institutions controlling water resources that make them available to new and existing users as it is the physical infrastructure and the natural characteristics of the water itself.

Based upon the information gained in the first two investigative steps, it was then necessary to characterize the water commodities themselves. In few market areas are there only one "type" of water available for sale. Several different marketable water commodities usually co-exist, different in the nature and extent of their spatial and temporal

availability their chemical quality, their security, flexibility, transferability, divisibility, and cost.

A fourth step involved an elaboration of the initial description of the market. Market structures are described in terms of the numbers and types of potential buyers and sellers, the nature of their demand for water, the cost of alternative sources of supply, and the competitiveness of the price determination process. The relative ease with which buyers and sellers can collect information on marketable water resources and the opportunities for negotiating the terms and conditions of sale are also of interest.

The final step involved the collection of price and quantity data on actual market transactions. The data are catalogued, and described and examined for identifiable trends over time.

II. MARKET DESCRIPTION AND COMPARISON

A. WATER MARKETS IN SOUTHERN ARIZONA

1. General Description of the Study Areas

The two market areas in Arizona chosen for study are the Tucson and Phoenix Active Management Areas (AMA's). These AMA's were two of the four AMA's created in the comprehensive Groundwater Management Act of 1980. The Phoenix AMA includes the Phoenix metropolitan area and most of the populated areas of Maricopa County. The Tucson AMA includes the Tucson metropolitan area and parts of Pima, Pinal, and Santa Cruz counties.

None of the four criteria for selecting water markets are fully met in either of these market areas. Neither has a long or continuous history of water transfers, and the levels of market activity have never been high. The two most important market transfers of water in the Phoenix AMA involve water rights originating from far outside the AMA, while transfers of water rights within the AMA itself appear to be virtually nil. Some additional water rights may be developed within either AMA under special circumstances, and within the next few yers another million to a million and a half acre feet of new water per year will be imported into the Phoenix and Tucson areas via the Central Arizona Project.

The Arizona market areas were nevertheless included in the analysis for two reasons. First, both exhibit some potential for hightened market activity in the future. Second, the barriers to water rights trading are higher in Arizona than in any of the other five states of the Southwest. The fact that water markets have come into existence at all and that they are slowly gathering momentum in spite of all the difficulties is of interest. With respect to the rest of the market areas studied, those in Arizona may be said to represent the "worst case" examples.

Approximately half of all the water used in the state of Arizona is pumped from groundwater aquifers which are being depleted about twice as fast as they are being replenished. The Salt River Project (SRP) provides substantial quantities of surface water flows from the Salt and Verde Rivers for users in the Phoenix AMA. This supply is supplemented heavily with groundwater pumping. Water supplies in both AMA's will be augmented with Colorado River water to be delivered via the Central Arizona Project (CAP). Limited CAP deliveries began to the Phoenix area in 1985, and the project is expected to begin serving the Tucson area in the early 1990's. The SRP provides water and power to the rapidly growing metropolitan centers of Phoenix, Mesa, Tempe and Scottsdale, several smaller cities and towns, and thousands of acres of irrigated agricultural lands. Water users outside the SRP either operate their own private water systems or contract for water from any one of several dozen different small to medium-sized water service organizations.

The level of integration of the various water delivery systems in Arizona has been low. The situation will change somewhat with the introduction of the CAP, a large canal system delivering water from the Colorado River over 300 miles to the Phoenix and Tucson areas. A number of new irrigation districts have been created solely for the purpose of paying for and delivering CAP water to farmers in the project service area. Some of these districts plan to assume control over all groundwater pumping within their boundaries and manage this resource conjunctively with CAP supplies. More significantly, however, the CAP will provide a physical linkage for the first time among major water producers and users in Central Arizona. The construction of the CAP canal has fueled interest and speculation regarding expanded potential water market activities. (Kelso)

Over 85 percent of the water used in Arizona is used by irrigated agriculture. The number of irrigated acres in the state peaked in the early 1960's, and has been declining steadily as farmland is retired for urban development. While agricultural is gradually declining in size and economic importance, the nonagricultural sectors of the economy, especially around the metropolitan centers of Tucson and Phoenix continue to expand at a rapid pace.

2. Research Activities in the Study Areas

To a far greater extent than in any of the other market areas, the complexity of Arizona water law necessitates a careful analysis of the legal basis for water rights and water rights transfers. Conversations with Arizona legal and administrative authorities were helpful in clarifying the legal framework for Arizona water markets. Information on water rights holdings and a very limited record on past water rights transfers was available from the state Department of Water Resources. The Bureau of Reclamation and the Central Arizona Water Conservancy District provided information on the CAP. Limited price data were collected from an attorney and an investor who had brokered some water transactions. Other data were collected from municipal governments and from private individuals who had bought or sold water rights.

3. Water Rights Laws and Institutions

Arizona has evolved a dual system of water rights. Surface water rights are developed under the appropriation doctrine common to the western United States. Groundwater rights are developed under a permit system.

What are usually referred to as surface water rights in Arizona are both narrower and broader than the name implies. They are narrower in that

they pertain only to surface waters flowing in defined natural channels, thus not to nonflowing surface water such as lakes or to waters moving across the surface in undefined channels. The rights to surface waters are broader than the name implies in that they also pertain to subsurface (or ground) water moving in defined subsurface channels with definite beds and banks. Underground flows constitute a small proportion of surface water in the state. Surface water rights in the Phoenix AMA were adjudicated under two separate court decrees. The Kent Decree of 1910 adjudicated the water rights in the Salt-Verde River system, which forms the watershed for the SRP. The Bensen-Allison Decree of 1917 further adjudicated rights in the Salt River, as well as rights to the Agua Fria and the GilaRivers. (Arizona Department of Water Resources)

Rights to the Colorado River have been defined under a series of interstate compacts, court decrees, and legislative acts which have become known collectively as the "Law of the River." Colorado River allotments are assigned to each of the states in the Colorado River basin, and formulae for prorating these allotments in the event of shortfalls in the river have been established. To date approximately a million acre feet per year of Arizona's allotment of 2.8 million acre-foot allotment of Colorado River water has not been used. The remaining unused allotment will be totally developed with the completion of the CAP.

Prior to 1962, appropriative rights were not transferable by their holder to land sites other than that specified in the original granting of the right, whether unilaterally for their own purposes or by assignment to another. The only exception to this locational inflexibility of surface water rights arose when the original site was destroyed or impaired by natural calamity. Under such circumstances the right could be moved with approval by a state administrator or court.

In 1962 this legal restraint was reversed and surface water rights are, at least in principal, freely transferable to other lands with or without a change in the purpose of use. Surface water transfers continue to be hindered by legal conditions on transfers, however, and few have ever taken place. (Kelso, Morton, & Mack)

Use of groundwater in significant amounts did not occur in Arizona until the 1920's and it was not until the 1940's that noticeable depletion of groundwater aquifers began. During this time the state legislature made few serious attempts to define and protect groundwater rights, relying instead on the courts. In the early 1900's Arizona witnessed contradictory court decrees in which the state attempted and failed to follow one legal doctrine of groundwater administration after another. The passage of an ineffective groundwater management code in 1948 did little to ease the conflicts and confusion. In 1980 the state legislature finally passed a strong groundwater management code. The new law established a strict permit system for groundwater rights and created a powerful state agency to oversee the granting and administration of all water rights.

The Groundwater Management Act of 1980 accomplished three objectives which had long eluded state authorities. First, it created a strong, centrally-controlled administrative mechanism for regulating water resources development and use. Second, it set up a system for defining and quantifying groundwater rights. Third, it established a set of clearly defined management goals and an agenda for state-wide groundwater management.

Under the Act four administrative regions, or Active Management Areas (AMA's) were created to operate under the direction of the state Department

of Water Resources. Their purposes are 1) to grant and manage water rights as defined in the legislation and 2) to establish and administer water conservation and supply augmentation programs with the ultimate objective of eliminating groundwater overdraft in Arizona by the target year of 2025.

There are four basic classes of water rights within AMA's. These are (1) exempt withdrawals, (2) Grandfathered rights, (3) Service Area rights, and (4) Withdrawal permits.

Withdrawals of groundwater for nonirrigation domestic uses from wells with pump capacities of not more than thirty-five gallons per minute, or for nonirrigation commercial uses not exceeding ten acre-feet per year are exempt from most regulation under the law. Nonirrigation uses include the irrigation of less than two acres of land. Individuals may continue to appropriate water for exempt purposes in AMA's without interference, so long as they conform to state specifications on groundwater well spacing. These regulations are intended to mitigate the adverse impact that a new well could have on existing neighboring groundwater users nearby.

There are three types of Grandfathered Rights (GFR's): Irrigation GFR's, Type I Non-Irrigation GFR's, and Type II Non-Irrigation GFR's.

An irrigation GFR applies to two or more acres irrigated between January 1, 1975 and January 1, 1980 for the purpose of growing plants for sale or human consumption or to use as feed for livestock or poultry. An Irrigation GFR is a right to irrigate land with groundwater but does not specify the amount of water that may be used on the irrigated acreage.

The extent of the irrigation water right on any particular parcel of eligible land is formulated by the local AMA on the basis of three factors. These factors are the water duty per acre, the number of grandfathered acres, and the number of water duty acres. The number of grandfathered irrigation acres is the number of acres that were irrigated at <u>any</u> time

during the five-year period prior to 1980. The number of water duty acres is the maximum quantity of the grandfathered irrigation acres that was irrigated in any one of the eligible years. The number of water duty acres may be significantly less than the total number of grandfathered irrigation acres.

The maximum quantity of water that may be used per grandfathered irrigation acre is the product of the water duty and the ratio of the number of water duty acres to the number of grandfathered acres. If the water duty is equal to 4 acre-feet per acre, for example, and there are 80 water duty acres and 100 grandfathered irrigation acres, the maximum water allowance per grandfathered irrigation acre is 3.2 acre-feet. Irrigators may choose in any year to irrigate all of their grandfathered irrigation acres and spread out their water rights relatively thinly, or they may irrigate fewer acres and concentrate their water rights.

The irrigation water duty is determined on the basis of the historic use of water per irrigated acre. As conservation requirements increase over time, each AMA will progressively reduce the allowable water duty. The number of grandfathered and water duty acres on any given parcel of land will neither increase nor decrease over time. The total water right available for irrigators will therefore gradually diminish as water conservation requirements call for reductions in the water duty.

Type I nonirrigation GFR's apply to farmland retired from irrigation after January 1, 1965 in anticipation of a specific nonirrigation use. Type I GFR's recognized in 1980 with the enactment of the Groundwater Management Act are granted three acre-feet per acre. Subsequent to 1980 a Type I right converted from a retired grandfathered irrigation right allows

a right-holder to pump the lesser of a) three acre-feet of groundwater per acre from the retired land or the maximum water allowance per grandfathered irrigation acre.

Type II nonirrigation GFR's apply to nonirrigation withdrawals of groundwater occuring when the AMA's were established. Generally the quantity of water assigned to a Type II right equals the maximum amount of water withdrawn and used for nonirrigation purposes in any one of the five years before the designation date of the AMA's. No new Type II rights may be created after the designation of an AMA.

Cities, towns, private water companies and irrigation districts have "service area rights" to withdraw and transport groundwater. The groundwater law defines the service area of a city, town or private water company as the area of land actually served by the entity and any additional areas that contain an operating distribution system owned by the entity and used primarily for the delivery of nonirrigation water.

A city, town or private water company has the right to withdraw as much groundwater from within its service area as it needs to serve residents and landowners within the service area. The quantity of water rights available to a service area are not fixed. While irrigation water rights will gradually shrink over time, service area rights can, at least in principle, expand over time. The state will attempt to limit the expansion of service area rights by mandating reductions in the per capita rate of use of water within the service area.

Those who are not eligible for GFR's or service area rights may obtain the right to withdraw groundwater for non-irrigation purposes by applying for a temporary groundwater withdrawal permit. If certain criteria are met, the Department of Water Resources may issue permits for new or

expanded non-irrigation uses of groundwater. Groundwater withdrawal permits specify limits on both the duration and amount of withdrawals.

Two additional water rights found in Central Arizona which are neither permitted or appropriated--CAP water and sewage effluent. CAP water has been appropriated by the state of Arizona and is available to local water service organizations on a contractual basis. The legal status of effluent is not entirely clear.

CAP water rights are controlled by the Central Arizona Water Conservation District (CAWCD), which acts as the intermediary between project water users in Arizona and the United States Bureau of Reclamation. Water users, represented by water companies, municipal water service organizations, or irrigation districts, contract with the CAWCD for CAP water service. The contracts do not permit the sale and transfer of CAP water or water rights to third parties. All return flows from the use of CAP water are the property of the CAWCD and are also not available for sale, reuse or transfer. Allotments of CAP water for agriculture can be converted to M&I allotments at the rate of one acre-foot of CAP water per acre of retired farmland. (Bureau of Reclamation)

The degree of access to CAP water differs depending upon the type of use. Most Indian and all M&I uses enjoy top priority for CAP deliveries. After all high priority uses are satisfied, irrigators will be served. CAP water allocations for agriculture that are converted to M&I use, however, will enjoy the same level of priority as all other M&I users.

In recent years treated sewage effluent has begun to receive increasing attention for its potential in securing potable water supplies from irrigators through exchange agreements, in satisfying Indian claims to water rights, in recharging groundwater aquifers, and as a marketable

resource. Effluent has recently been recognized in the Arizona state court system as a water right separate from native ground or surface water sources. (Maricopa County) Until and unless this decision is successfully appealed or new legislation is passed specifically dealing with effluent, effluent will continue to elude regulation under state water law. It is legally (if not practically) one of the most flexible water commodities in Arizona. Small quantities of effluent have been bought and sold in Arizona to date, and the possibility of marketing it further is being actively discussed.

A water user who wishes to acquire new or additional groundwater rights but for whom exempted rights or temporary use permits are not feasible may lease or purchase a GFR. Most permittted rights issued pursuant to the 1980 Code may be transferred, but usually they are only available for the same type of use, the one major exception being the convertibility of an irrigation right to a Type I nonirrigation right. All transfers are subject to certain restrictions and must be approved by the Director of the Department of Water Resources. Temporary use permits may not be transferred.

Grandfathered irrigation rights are appurtenant to the land for which the right was granted and may not be severed from that land. The full quantity of the water right must change ownership with the sale of the land. Grandfathered irrigation water may not be used for any purpose except irrigation and, in some cases, livestock watering. The water rights may only be used on the land for which the right was granted or on contiguous acreage under common ownership. The only exception to the strict appurtenancy rule for grandfathered irrigation rights is that a landowner may petition to substitute flood-damaged acres for other irrigation acres and transfer the water right.

Type I nonirrigation rights, or grandfathered irrigation rights which have been converted into Type I nonirrigation rights, are also strictly appurtenant to the land where the right originated. The full amount of the right is conveyed with the sale of the land. However, any quantity of water up to the limit of the right up may be transported off the land to nonirrigation uses in other locations. Type I water may be transported within, between, or outside existing AMA's without liability or injunction.

If a Type I right has been converted from an irrigation right, the irrigated land must be permanently retired from agriculture. The amount of the Type I right is determined at the time of the conversion to nonirrigation use and will remain fixed at that quantity for all future conveyances. Type I water may not be used for irrigation, and the right cannot be converted back to a grandfathered irrigation right.

A water user intending to retire irrigated land and use the water for nonirrigation purposes must file a development plan with the Department of Water Resources for approval. Grandfathered irrigation rights may only be converted to Type I nonirrigation rights if the land is not already within the service area of a water purveyor. However, conversions will be allowed if the development plan for retiring the irrigated land was filed and approved prior to the land's inclusion in a water service area.

Type II nonirrigation rights are the only water rights (other than any rights associated with sewage effluent) that are not strictly appurtenant to a particular parcel of land. Within any given AMA Type II rights may be freely transferred, subject only to regulations on the spacing of groundwater wells if the transfer necessitates the drilling of a new well.

Type II rights may not be used for irrigation, and are limited in the range of possible nonirrigation uses. Rights currently assigned for use in

power generation may not be used for any purpose other than power generation, and rights used for mineral extraction are confined to mineral extraction uses. Probably the single greatest limitation on the transferability of a Type II right is the legal requirement that the entire right must be conveyed in a sale. The flexibility and the marketability of a Type II right is severely impaired by this non-divisibility stipulation.

In summary, there are nine different types of water rights available to water users (other than Indian water users, who represent a special class of users beyond the scope of this study) in the Tucson and Phoenix AMA's. They differ in their respective degrees of tenure or delivery security, the number and types of alternative uses to which they can be put, and the relative ease with which the water or the right may be transferred: The nine categories of water rights are described further in Appendix A.

4. Water Market Activity

Interesting water market activity is occuring in Arizona. Examples may be found of sales of all the different types of marketable water rights in Central Arizona. These include markets for Type I (retired farmland) and Type II grandfathered rights, adjudicated surface flows, and sewage effluent.

One of the oldest and most continuous water markets in Arizona is the ongoing acquisition by the city of Tucson of irrigated farmland in the Avra Valley. Tucson has contemplated developing water rights in the valley, located beyond the Tucson Mountains about fifteen miles west of the city since at least the 1940's. At the time there was very little development in the Avra Valley. Irrigated agriculture did not begin in the area on any significant scale until after the Second World War. However, by the time

Tucson acquired some parcels of land and developed a wellfield and a transmission system to convey the water into the city in the mid-1960's irrigated agriculture had become a major industry. (Parker)

The transportation of Avra Valley water into the Tucson basin began in 1968. Shortly afterwards a series of lawsuits contesting the transportation was filed against Tucson. The litigation was not settled for several years. In 1971 Tucson began purchasing farmland in the Avra Valley in the vicinity of its wellfields. At the time there was no comprehensive groundwater management law in Arizona, and the city was not required to purchase land to secure its water rights. The motivation for acquiring farmland was two-fold. First, it was a means of eliminating potential plaintiffs to additional lawsuits against the city. Second, by purchasing and retiring the farmland the city could presumably control and reduce the rate groundwater overdraft in the valley and extend the life of the groundwater aquifer. (Parker)

Over the eight-year period from 1971 to early 1979 Tucson acquired over 13,000 acres of irrigated land and brought farming to end in the southern Avra Valley. At that point the city council called a moratorium on further land acquisitions until the fate of the state's efforts to enact new groundwater legislation could be determined. The new legislation provided for the first time a formal legal basis for Tucson's land acquisition program. In 1984 Tucson resumed purchase of Avra Valley farmland, and by the close of 1985 another 6,000 acres of farmland had been purchased and retired. The city expects to acquire the remaining 20,000 acres of privately owned irrigated land in the central and northern portions of the Avra Valley over the next 25 years. It is uncertain at this time what will happen to the 8,000 acres of Avra Valleyfarmland owned and leased by the state. (Parker)

Several outcomes of Tucson's land acquisition program in the Avra Valley are apparent. First, Tucson has succeeded in securing a large supply of groundwater rights for the city which may be developed at its leisure. Second, the quality of Avra Valley groundwater is higher than Tucson basin groundwater, and the intermingling of the former with the latter has measureably improved water quality in the city's system. Finally, the city is pumping far less water from Avra Valley land than was pumped under irrigation. As a result, the rate of groundwater table decline has fallen off dramatically, ensuring a large and relatively inexpensive water supply for the city for many years to come.

Tucson's total rights to Avra Valley groundwater are in excess of 55,000 acre-feet per year, or nearly two-thirds of the current annual level of water usage in the city. In recent years Tucson has been pumping between 5,000 and 6,000 acre-feet per year from the Avra Valley wellfields. Pumpage is expected to rise to about 15,000 acre-feet per year just before the arrival of CAP water in the early 1990's. Pumpage will then decline sharply to about 2,000 or 3,000 acre-feet per year, or the minimum required to meet peak load demands on the city's water system. The level of water consumption in Tucson is projected to continue to rise beyond what could be expected to be provided through the CAP and wellfields in the Tucson basin, so pumpage from the Avra Valley will eventually rise again. (Brooks)

Prices in constant 1984 dollars for land purchased in the Avra Valley have ranged between $1,000 and $2,000 per acre. If one assumes that the land and improvements have no value once the appurtenant irrigation rights have been retired for city use, and that the transferable water rights averaged three acre feet per acre of irrigated land, then the purchase price for water rights has ranged between about $400 and $1,100 per acre-

foot. The city spends about 150,000 per year to prevent dust and weed nuisances on its Avra Valley property. (Parker)

A second example of the acquisition of farmland for the conversion of grandfathered irrigation rights to Type I rights involves the city of Mesa, located in the Phoenix AMA. In the spring of 1985 Mesa purchased over 11,500 acres of irrigated farmland with a potential yield of over 30,000 acre-feet in Type I water rights. The farmlands lie approximately 25 miles to the south in neighboring Pinal County (Pinal AMA). Mesa intends to lease the land back to farmers for about 15 years until the city is ready to apply the water rights for municipal use. If necessary, Mesa has stated a willingness to pipe groundwater all the way into the city from the retired farmland. As a cheaper alternative, however, Mesa is attempting to get approval from the Department of Water Resources for plan to exchange groundwater for CAP water. The plan is to pump groundwater from the farmland into the CAP aquaduct and let it flow south to Tucson. In exchange, Mesa would pick up an equal quantity of CAP water (water meant originally for Tucson) upstream at the city's diversion point for the CAP.

The total cost of purchasing the 11,500 acres of land and 30,000 acre-feet of water rights was over $29 million. Prices ranged between $1,900 and $3,000 per acre, with an average price of about $2,600 per acre. The water rights cost an average of about $1,000 per acre-foot assuming no value for any improvements acquired with the land. Mesa does not yet have cost estimates for any of the alternative systems to deliver (or exchange) the groundwater to the city. (Kolhoff)

Type II nonirrigation grandfathered rights have been bought in sold in both the Phoenix and Tucson AMA's, where nearly all the Type II rights are concentrated. Most transfers of Type II rights have been part of larger real estate deals involving land and improvements as well, and little can

be inferred about the implicit market value of the rights in these sales. A small number of Type II rights have been sold separately. A few have been acquired by individuals seeking to invest in water rights. Some businesses have acquired Type II rights believing them to be a cheaper means of getting water than hooking up to a municipal water system. Finally, some individuals have purchased Type II rights in the interest of starting their own water service organization. These have primarily been for real estate developments outside of any existing water service areas. (Rossi)

Sales prices for Type II water rights have ranged from a high of $2,000 per acre foot to as little as $300 per acre-foot. The most typical price, at least in the Tucson AMA, appears to be about $600 per acre-foot.

A possible new market for either Type I or Type II water rights may be the leasing of water in order to open new water service areas. Under Arizona law, the service area for a water service organization is not necessarily the same as the area within which it has the legal authority to provide water service. The former consists of the area physically served with water. The latter is little more than a boundary line on a piece of paper, including the official service area but conceivably extending far beyond it. Water service organizations can only withdraw groundwater from within their official service areas. It is often difficult for a water service organization, especially a new one, to provide new water service without having the water resources on hand first. A possible solution is to lease water rights only long enough to establish water service, then apply to the state for service area rights in order to obtain a new water allocation. (Tinney)

The most well-known example of the acquisition and transfer of surface water rights is that of the city of Scottsdale, located in the Phoenix AMA. In the spring of 1984 Scottsdale purchased the Planet Ranch, an 8,400 acre ranch and alfalfa farm in La Paz and Mohave Counties, not far from Havasu City and the Colorado River. The source of water for the Planet Ranch is the Bill Williams River. Scottsdale hopes to divert its water into the CAP aquaduct for transportation to the city.

Since the water rights for the Planet Ranch are appropriated rights and subject to beneficial use requirements, Scottsdale will continue using them for agricultural purposes until they can be incorporated into the city's municipal water system. The precise quantity of water rights acquired in the purchase of the Planet Ranch and the proportion of those rights that may be removed from the river to send to Scottsdale have not yet been determined, although estimates place the quantity available for export at about 13,500 acre-feet per year. Aware of this uncertainty, Scottsdale included a clause in the purchase contract specifying adjustments in the ultimate sales price for the ranch should the water rights prove to be less than originally estimated.

The total cost of acquiring the Planet Ranch was $11.6 million. In addition, Scottsdale has had to invest close to another $4 million in improving the ranch facilities and preparing land for irrigation. Additional operating losses over the next few years are estimated to total another $1.5 million. Scottsdale expects to break even on operating costs by 1987. Adjusting for inflation, the present value of the costs for Planet Ranch equal about $16 million. If the ranch does in fact yield 13,500 acre-feet of water, the cost for the water will be about $1200 per acre-foot. If the water resources turn out to be less than the expected

quantity, the purchase agreement calls for a reduction in the sales price of $870 for each acre-foot not supplied below 13,500 acre feet. (Duker)

These cost estimates for the Planet Ranch do not include the cost of building a canal to convey the water from the Bill Williams River to the CAP aquaduct. The canal, which is estimated to cost $17 million, is not a physical but an institutional necessity for the successful delivery of water to Scottsdale. Since the Bill Williams River empties into the Colorado upstream from the CAP intake at Lake Havasu, it would seem a trivial matter to simply let the water rights stay in the river and exchange them down into the CAP. However, due to the peculiarities of the law of the river, allowing Scottsdale's appropriation of Bill Williams water to flow unimpeded into the Colorado would be tantamount to losing the right. Once the water mingled with the Colorado, it would take an interstate agreement among the lower basin states of Arizona, California and Nevada to reallocate the water to the CAP. The construction of a canal bypassing the Colorado River is the more expensive but politically safer alternative. (Duker)

Other "water ranches" acquired in western Arizona include the Lincoln Ranch, owned by Vector Interests, Limited, and the Crowder-Weiser Ranch, acquired by the American Continental Corporation in April, 1985. The 1,000 acre Lincoln ranch is located upstream along the Bill Williams River from the Planet Ranch. The company hopes to obtain between 7,000 and 7,500 acre-feet of water per year for use on real estate developments in Central Arizona. Informal discussions have been carried out with the city of Scottsdale to share in the cost of building a canal from the Bill Williams to the CAP aquaduct. (Michaelis)

The 5,500 acre Crowder-Weiser Ranch near Vicksburg in La Paz County is expected to yield between 20,000 and 30,000 acre feet a water per year. American Continental also hopes to use its water resources to support real estate developments in the Phoenix and Tucson areas. There are no definite plans yet on how to move the water into Central Arizona, although it is .PA likely that efforts will be made to link the ranch's water supply with the CAP. (Michaelis)

Pima County in the Tucson AMA has been selling approximately 3,500 acre feet of secondary treated sewage effluent to farmers in the Cortaro-Marana Irrigation District for several years at $5 per acre-foot. The City of Tucson, which currently controls over 90 percent of all the sewage effluent produced in the metropolitan area, has been reluctant to sell any of its share. Long term plans call for the substitution of as much secondary and tertiary-treated effluent for ground-water withdrawals as possible in the city. Effluent uses include watering golf courses and urban parks and the initiation of groundwater recharge programs. City ordinances require all new golf courses within the city limits to purchase and use effluent. Effluent for golf courses must sometimes be given tertiary treatment because of the open access to irrigated areas. Charges for Tucson effluent are running over $300 per acre-foot.

One perceived advantage of recycling effluent within the city system is based on an interpretation of the groundwater law. Per capita conservation use limitations imposed by the Tucson AMA are confined to the use of groundwater and CAP water. Effluent is not counted. By substituting effluent for potable water, the city can free up more water and effectively raise per capita usage without exceeding the AMA prescribed limit. Even with the development of an ambitious program of recycling as

much effluent as possible, and even if the Papago Indians used all the effluent that was promised to them under the Southern Arizona Indian Water Rights Settlement Act, the projected increases in Tucson's effluent production appear to easily outstrip all possible uses for it within the city. It appears likely that Tucson may one day begin marketing its surplus effluent for irrigation or for other purposes outside of its service area. (Goldhammer)

Another example of sewage effluent marketing is the agreement between the Palo Verde nuclear power station and several the cities of Tempe, Phoenix, Mesa, Tolleson and Scottsdale. The agreement, first signed in 1973, includes four separate purchase options. If all are exercised, they would provide 140,000 acre-feet of effluent annually to cool the plant's reactors through the year 2040. The original price for the effluent was set at $30 per acre-foot, or 40 percent of the cost to M&I users of CAP water, whichever would be lower. A recent suit challenged the agreement and forced renegotiation on the price. The contract as amended set the price for the effluent equal to the cost of CAP water for the cities, which is now expected to be at least $300 per acre-foot. (US Water News)

B. WATER MARKETS IN NORTHEASTERN AND SOUTHEASTERN COLORADO

1. General Description of the Study Areas

The two market areas chosen for study in Colorado are the Northern Colorado Water Conservancy District (NCWCD) and the Southeastern Colorado Water Conservancy District (SCWCD). The NCWCD includes irrigated and dryland farming areas and towns and cities in the South Platte River basin. The principle metropolitan centers included in the district are the cities of Boulder, Fort Collins, Greeley, Longmont, and Loveland. The SCWCD includes irrigated and dryland farming areas and towns and cities in the Arkansas River basin. The principle metropolitan centers included in the district are the cities of Pueblo, Fountain, and Colorado Springs. Another city located outside the district in the Denver area, Aurora, is attempting to purchase and transfer some water rights in the SCWCD and is therefore included in the discussion as well.

Market conditions for trading water in the NCWCD are among the most favorable found anywhere in the southwestern United States. All of the basic criteria for selecting a market area for study were met. Conditions in the SCWCD are far less congenial to water marketing. Two of the criteria for selection were not fully met, those requiring a consistent history and a sustained level of market activity. The contrast between the water markets is all the more interesting since the NCWCD and the SCWCD are governed by the same system of state water law and similar economic forces. However, the two areas differ widely in organization of local water institutions, in physical infrastructure, and in hydrological characteristics.

The predominant source of water in both market areas is mountain stream runoff. The natural supply of surface water is supplemented heavily

with transmountain diversion projects and to a small degree with groundwater pumping. Transmountain diversion water quality is quite high. Most native stream water is of a high quality also, except for flows in the lower reaches of the Arkansas River where salinity levels are significant (Miles, 1977). Groundwater quality varies depending upon its location but generally the quality is lower than that of surface flows.

Nearly all native water supplies appropriated for use below (east of) the front range of the Rocky Mountains are controlled by mutual stock irrigation companies, private irrigation companies, rural-domestic water districts, or municipal water service organizations. Some native water flows, especially in the upper reaches of the Arkansas River, are still held under individual appropriation decrees. However these quantities are relatively small and inconsequential (Anderson).

There are two major transmountain diversion projects in the NCWCD, the Colorado-Big Thompson Project (C-BT) and the Windy Gap Project. The C-BT was the first and the largest transmountain diversion project in Colorado. Built by the Bureau of Reclamation in the late 1950's, the C-BT delivers up to 310,000 acre-feet of water per year to agricultural and M&I users throughout its service area. The locally financed and newly completed Windy Gap Project, which began deliveries in 1985, promises to furnish an additional 48,000 acre-feet of additional water for the area (Hollar, 1984).

Over a dozen transmountain diversion projects have been constructed to serve the Arkansas River basin, although none approach the size of the C-BT. Most of the projects are wholly owned by municipal water service organizations. The two major exceptions are the Twin Lakes and Frying Pan-Arkansas Projects, both constructed by the Bureau of Reclamation.

The Frying Pan Arkansas Project (FPA) is the largest transmountain diversion works in the Arkansas River basin. Just as the NCWCD was formed to repay the federal government for construction costs and manage the C-BT Project, the SCWCD was formed to pay for and manage the FPA. The FPA delivers approximately 80,000 acre-feet of water to agricultural and M&I users in the SCWCD, of which about 70 percent of the water comes from transmountain diversions. The remaining 30 percent is developed from "storable flood waters" of the Arkansas River and its tributaries (Southern Colorado Water Conservancy District).

The Twin Lakes Project is an enlargement of the old Twin Lakes Reservoir and Canal Company system, which originally handled only native flow waters. The reservoir is now partly owned by the federal government and partly by the Twin Lakes Reservoir and Canal Company. The shares of mutual stock that may be bought and sold on the market represent only that portion of the water and storage space in the reservoir controlled by the private water company. All remaining storage space in the reservoir is used to support the Frying Pan-Arkansas project. Roughly 10 percent of the total average annual yield on Twin Lakes stock is attributed to native flow, while the rest represents transmountain diversion water rights deeded to the company by the Bureau of Reclamation (Dingess).

Ownership of Twin Lakes stock entitles the holder to both a share of the water delivered by the company, and the use of stoage space in the reservoir. About 50,000 acre-feet per year are delivered by the Twin Lakes company. Originally it supplied water only to irrigators, but now the company is almost completely owned by the cities of Aurora, Colorado Springs, Pueblo, and Pueblo West (Miles).

The system of capturing, storing and distributing water resources in the NCWCD constitutes one of the most integrated and complex water service infrastructures in the southwestern United States. Dozens of different water service organizations coordinate and share in the operation of hundreds of miles of canals, storage reservoirs, pumping facilities and water treatment plants serving an area roughly equal in size to the state of Conneticut. Through cooperative exchange agreements the many different water service organizations can adjust the timing and volume of water deliveries to meet a wide variety of demands.

Although the SCWCD covers a large area comparable to that served by the NCWCD, the physical infrastructures are not nearly so well integrated. Whereas population and economic activity is spread out throughout the South Platte Basin, they are concentrated in fewer areas in the Arkansas: along the base of the front range, in the Fountain Valley (a tributary to the Arkansas) and along the narrow band of the Arkansas River itself. Storage facilities are fewer and the opportunities for inter-oranizational water exchanges less.

Irrigated agriculture, the predominant water user in both market areas, reached its peak many years ago. Rapid urban expansion, especially in the city of Colorado Springs and in every metropolitan center throughout the NCWCD, has caused irrigated land to be retired and developed. Growth has also brought pressures to transfer water rights out of irrigation to M&I uses. The process has been gradual and continuous in the NCWCD, but uneven and sometimes abortive in the SCWCD.

The geographical location of water resources and centers of population and economic activity in each of the two areas has had a strong influence over the nature of the water markets. In the NCWCD the newer, nonagricultural water users are intermingled with the older users.

Expanding urban developments often acquire additional water rights by expanding onto previously irrigated farmland. Urban development tends to replace irrigated agriculture in a relatively smooth pattern of transition.

In contrast to the relatively unencumbered transfers of water rights in the Platte River basin, transfers in the Arkansas River basin have been complex and difficult. The main centers of population growth and new economic activity in the NCWCD are clustered about the centers of Pueblo, Colorado Springs, and Fountain (and Aurora), far upstream from traditional agricultural water users. Transferring water rights from the old water users to the new ones does not simply involve a change of land use within the same general area. Instead water rights must be transferred and exchanged over many miles. Conflicts over legality and equity cloud every major water rights transfer proposed. It is not surprising that the cities of Colorado Springs and Aurora are continuing to push ahead with the approval and construction of the second and third phases of another transmountain diversion work, the Homestake Project.

2. Research Activities in the Study Areas

Site visits were conducted during the spring, summer and fall of 1985 in order to interview market actors and to collect price data. Most efforts concentrated on the water market in the NCWCD. Since the great majority of water rights transfers consisted of purchases by water districts or municipal governments, a sizeable quantity of data on water rights transactions were available as public information. The quality of the records-keeping systems varied from locality to locality, however, so price and quantity data were not uniformly accessible.

Interviews were conducted with representatives of nearly every significant water-related type of organization in each of the market areas.

Not all of these were directly involved in the marketing of water rights, but all were involved in some way with the handling or study of water rights. Individuals that were interviewed included real estate developers and brokers, city officials, rural-domestic water district managers, irrigation district managers, bankers, river commissioners, farmers, and agricultural extension agents. Some secondary materials were available on the C-BT project and other water service organizations in the NCWCD from research faculty at the local universities.

3. Water Rights Laws and Institutions

Water rights in Colorado have been subject to the legal doctrine of prior appropriation since statehood was declared in 1876. All appropriated rights must be put to beneficial use or risk forfeiture.

Surface water rights in Colorado are of two different types, stream flows and reservoir rights. Appropriated stream flows are generally quantified in terms of flow rates and priority dates. Appropriators may withdraw water from the stream at specified maximum flow rates (cubic feet per second) so long as the flow rate in the stream itself is at or above some specified minimum level. The older the priority date, the lower is the minimum stream flow rate required to activate the right (Miles).

Reservoir rights are specified in terms of acre-feet of volume. During any given year the most senior reservoir right holders may fill their reservoirs to the capacity of their right first, followed by the next most senior right, and so on down the line to the most junior reservoir right. Reservoir rights are usually activated in periods of high stream flow (winter and spring runoff) prior to the beginning of the irrigation season (Heden).

Reservoir rights consist of two parts, the water right and the storage right. The water right is the right to fill the reservoir with a given quantity of water each year, according to priority. The storage right provides the holder with the right to use a given amount of space in the reservoir to store this or any other water right. The rights need not be for the same volume. Reservoir space may be bought and sold without necessarily any storage rights associated with it, although reservoir water rights are useless without also having some access to storage.

The importance of reservoir rights in Colorado cannot be overemphasized. Most stream systems in Colorado are extremely variable, alternating between periods of flood and drought. Without a means of regulating water supplies, appropriators in Colorado could not normally expect to have reasonably secure water supplies unless they held either very senior water rights or a quantity of rights far greater than their average use, or both. Storage facilities can increase the effective volume and thereby the value of a water right. They allow users to regulate the timing and volume of its release to conform to their patterns of use with miminal waste. Supply fluctuations can be smoothed out and waste reduced by storing unused water during periods (or years) of high water flow and releasing them for use when natural water flows are low.

Another important advantage of having access to water storage facilities in Colorado is that they facilitate the practice of water exchanges. Water exchanges are one important means of optimizing the use of water resources and water rights that are unevenly distributed over time and space among two or more water users. A good example of an exchange that necessitates the use of reservoir space is an arrangement that the

city of Colorado Springs currently is attempting to work out in water court.

Colorado Springs currently releases much of its return flow unused into the Fountain River, where it flows down to join with the Arkansas just below Pueblo Reservoir. This water augments the natural flow of the Arkansas river and provides a windfall benefit for downstream appropriators. If Colorado Springs can win its suit in water court to get a decree recognizing its right to reuse some of this return flow, it intends to exchange it upstream for water in Pueblo Reservoir. Colorado Springs could then begin to appropriate some additional quantity of water out of Pueblo Reservoir, equal to the quantity of return flow it is now releasing into the Arkansas, less system losses. The water it claims in Pueblo Reservoir may then either be transported directly up to the city via the Fountain Valley Pipeline, or else exchanged upstream again to other reservoirs high in the Rocky Mountains. From that point Colorado Springs could divert the water by means of pumping and gravity flow through existing water works into its municipal system (Concer).

Without the presence of Pueblo Reservoir, any scheme by Colorado Springs to exchange its return flow for water in the Arkansas River would probably be infeasible. While the city generates return flow at sustained levels for 12 months out of the year, the natural flow of the Arkansas is much less dependable. It is only because Pueblo Reservoir captures and stores large quantities of water throughout the year that Colorado Springs has any chance at all of diverting water from the system upstream without adversely impacting the rights of other appropriators.

Water rights transfers in Colorado are often complicated by the fact that both flow rights and storage rights may change hands in a transaction. Due to the flexible nature of storage rights, their market value may

reflect far more than the value of the water that could be impounded in a single filling of the right. It is not unusual that a buyer will acquire a package of water rights for the express purpose of gaining more storage volume, and only incidentally to increase its inventory of decreed flow rights. Storage rights may increase the value and usefulness of not one but several different water rights possessed by a user, by allowing water be captured, stored, and/or exchanged in and through the reservoir several different times over the course of a single season. The storage right itself is only valid for a single filling of streamflow per year. But once the water is captured and used, the storage space is still available for other purposes. Users may refill their space in the reservoir with exchange water or divert water they have developed under another right into the reservoir. Turquoise Reservoir serves the latter purpose for the cities of Colorado Springs and Aurora. The storage space they own in this reservoir is an essential link in bringing Homestake project water and water from other scattered rights to each city.

The application of the appropriation doctrine to groundwater rights was a slow and uncertain process. The classic distinction made in most states between "percolating" groundwaters and those in "definite streams or channels" has not been important. Distinctions of greater legal significance are made between groundwaters which are tributary to a surface watercourse and those which are not.

Little legislative action is found concerning groundwater in the early history of Colorado due because groundwater supplies were not extensively developed until fairly recently. For most of the state's history, groundwater wells had been allowed to develop as if they took water from a source of supply entirely separate from the surface water streams. It was

inevitable that as more and more groundwater resources were developed, the effects would begin to be felt on surface water flows (Chalmers).

Both the Arkansas and Platte River basins are now closed to additional groundwater appropriation. Most existing groundwater appropriations are junior to most surface water appropriations. Those groundwater resources that are judged to be tributary to a surface water flow are limited in the number of days of each month that they can operate. If groundwater users wish to pump beyond the legal limit they are required to file an approved "augmentation plan" with the state to compensate for their impact on the surface stream flows. Alternative means of augmenting stream flows include acquiring and then retiring stream flow rights, releasing stored water into the stream, or purchasing another water user's return flow for release into the stream (Jesse).

Appropriation decrees for water rights in Colorado provide no volumetric limitation on the extent of a right. State law prohibits the wasteful use of water, but no specifications of what constitutes waste are given. Usually in order for land to be irrigated in Colorado it must either a) have an original appropriation of water rights appurtenant to the land, b) have existing water rights transferred to the land, or c) be included within the service area of a water company that supplies irrigation water. Irrigation water rights may be supplemented by renting additional water for any length of time desired (Jesse).

Under Colorado law the appropriative right to water is property right separate from the land on which the right is appurtenant. The land for which a water right was appropriated, or (in the case of land which is within the service area of a water service organization) on which the water is being used may be transferred with or without the water rights. Conversely the water rights may be transferred with or without the land,

and any part of the land may be transferred with any part of the water right and the remainder retained.

Water rights may be freely bought, sold or rented as a general rule. However, if the transfer of a water right involves anything more than a change in ownership the state must ensure that no existing water rights will be impaired. If the only change in a water right is a change in ownership, there is no limitation on the right to transfer and no approval is required by the state. Conveyance of a water right separate from the land, however, almost invariably is accompanied by some type of change in use, either in the point of diversion, place or purpose of use. Those changes are strictly limited to protect the rights of all other junior and senior appropriators on the particular stream system (Radosevich).

The state Supreme Court appoints a Water Judge for each of the seven administrative water districts in Colorado. Each judge must possess the training and experience to enable them to render expert opinions and decisions on water matters. In the judicial process in Colorado, the district water courts play the primary role in determining water appropriations and the merits of an anticipated transfer of water rights.

Colorado law specifies that whenever a change in point of diversion, place or purpose of use of a water right is being contemplated, the party which seeks to transfer the water right must bring suit in a district water court. The purpose of this litigation is to allow the court to hear all protests to the transfer so that no person with alleged property rights in the area affected by the water transfer will be injuriously affected. Change applications are generally approved if it can be demonstrated to the satisfaction of the water judge that the change will not adversely impact third parties. Changes might still be allowed in the face of third party

effects if the presumed injuries can be satisfactorily mitigated or compensated.

Water rights transfers are often difficult in Colorado. A major problem involves uncertainty with regard to how the water rights will be quantitatively defined by the courts. Uncertainty arises because different users of water are associated with a given set of appropriations and give rise to a particular set of return flow patterns. This set of return flows in turn gives rise to subsequent sets of secondary appropriations which vary with the availability of water as determined by return flow, storage facilities, groundwater sources, precipitation, and other factors (Hartman).

Under Colorado law there are no predetermined measures of consumptive use of water by economic activity and by geographical location. It is up to the water court to decide on an ad hoc basis the net impact on a stream system of a particular appropriation and then to deduce from the information available the average consumptive use of water from this appropriation. Generally it is the consumptive use portion of the water right, (the net quantity of water historically removed from the system under the existing appropriation) that is determined to be the quantity transferable to a new location and use.

Complicating the task and impeding the efficiency of the water court is the fact that it operates under adversarial proceedings. The state engineer is not consulted on proposed water rights transfers. Intead the courts call for engineering reports from the contesting parties. The petitioner for the water rights transfer is called upon to support their set of contentions relating to the transfer, and the protestants do likewise. Without the benefit of unbiased and professional engineering

skills and information, the court must make a choice or a compromise between conflicting testimonies.

The legal and institutional barriers to water rights transfers in Colorado are greatly reduced by means of two institutions and a pair of court rulings. The main advantage of each is that they manage to solve or circumvent the return flow problem. One institution is the legal status given to interbasin water transfers. The other is the presence of collective water service organizations, in particular the mutual stock irrigation companies. The pair of court rulings concerns the disposition of transferred native flow rights.

Unappropriated water in one hydrologic basin may be appropriated and transferred for use in other hydrologic basins through the normal legal and administrative channels. Once the water is moved into another area, however, the character of the appropriation changes. Users of "imported" or "foreign" water do not have the return flow obligations that users of "native" flows have to other appropriators in the area. Local appropriations are limited to the natural flows of the stream and exclude any rights to any additional (return) flows generated by the use of imported water.

Imported water rights imply dominion over the entire right. Holders of imported water rights may use and reuse and/or sell the water to extinction, so long as the water may be identified (Jesse). Suppose, for example, that a water user owns 100 acre-feet of transmountain diversion water and can demonstrate to the satisfaction of the water court that 70 percent of the water it uses returns to the stream system. It therefore has the right to recapture or sell the 70 acre-feet. Suppose it sells the 70 acre-feet of return flow rights to an irrigation company downstream,

which in turn can demonstrate that 30 percent of its use is return flow. The company may therefore in turn either recapture 21 acre-feet or sell it to yet a third party, and so on until the water is either abandoned, lost track of, cannot be identified to the satisfaction of a water court, or is totally consumed within the system.

Imported water may consequently be transferred and used anywhere within the basin to which the original appropriation was granted, without liability. Few water rights transfers involving imported water need to go through water court proceedings. The primary exception is when a user wishes to transfer some portion of all of their return flows to another party. Then the water court makes a determination of the consumptive use of the imported water in order to declare the volumetric limit of the transfer. Once this determination is made, third parties have no legal claim against the transfer.

The district water courts in the NCWCD and SCWCD have both handed down opinions that native flow rights which have been transferred have the same legal status regarding return flows as do imported waters (State of Colorado). Since only the consumptive use portion of a native flow right is transferable, and the consumptive use portion is by definition the quantity of water historically lost to the system, it may be presumed that no appropriators to native stream flows have any claim to the water. Rights to native flow waters that have already been transferred are therefore rights to the entire measure of the right, and may be used, reused and/or sold to extinction. Although the implications of the rulings of these courts have not yet seen widespread application in Colorado, they may have a significant impact on the future transfer and management of water rights (Dingess).

Water companies typically control a "bundle" of different water rights including decreed native flow rights, reservoir rights, and transmountain diversion water. The significance of company ownership of water rights is that the water is appurtenant to the company's service area as a whole and not to any specific parcel of land. All water rights managed within the company service area are legally recognized as having the same point or points of diversion (the diversion works for the company) and the same place of use (the company service area).

Individual water users in the company service area own a proportional interest in the company, most often represented by shares of stock. Dividends in the form of water allotments are declared on the basis of stock ownership rather than on land ownership. The size of the allotment will of course vary from season to season in accordance with the hydrologic cycles of the system, but the long term average yield and the variability of water service per share of stock are generally well known. The water stock, and the water service represented by that stock, are personal property that can be bought, sold or rented for any desired length of time within the company service area, without proceedings before the district water court. Transfers of water company stock require proceedings before the water courts under only two circumstances--if the contemplated transfer includes a change in the purpose of use or if the stockholder wishes to transfer water outside the company service area.

Water service organizations have many different perogatives that they may exercise with respect to the disposition of the water resources under their control. The specific management policies they adopt will ultimately determine the flexibility and marketability of the water they provide to their users. Nowhere is the effect of managerial perogative on the

flexibility of water rights more evident than in the various ways that alternative water service organizations handle transmountain diversion water. FPA water is not at all marketable among its users. C-BT and Twin Lakes water are both very marketable. Windy Gap Project water, while more difficult to market than either C-BT or Twin Lakes water, is still one of the most flexible water resources in Colorado.

Twin Lakes Reservoir and Canal Company water is marketed in virtually the same fashion as any other mutual water company stock. The only distinction is that a small portion of the water rights held by the company are recognized as native flow rights, while the rest are transmountain diversion water rights. When the city of Aurora, located outside of the Arkansas River basin, purchased some Twin Lakes stock and wished to transfer it to the city in the early 1970's, it had to petition for a water rights transfer before the district water court. It had to do so because they were transferring the stock outside of its decreed area of use in the Arkansas basin. To date Aurora has only succeeded in transferring the transmountain diversion portion of its Twin Lakes stock water rights. Should the city bring suit to transfer its native flow rights as well, the water court will have to determine the transferable (consumptive use) portion of the native flow rights. As a result, the yield on Twin Lakes stock held by Aurora averages slightly less than the yield on other shares of Twin Lakes stock held by other parties who have retained their rights within the Arkansas River basin (Dingess).

The FPA and C-BT were both conceived of as multi-purpose projects to supply supplemental water to existing irrigated lands and growing urban centers. The means of allocating water under each project, however, is very different.

Shortly after its creation in the late 1950's, the governing board of directors of the SCWCD decided that the allocation of FPA water would be fixed at 51 percent for municipal and industrial use and 49 percent for irrigation. The allocation may be changed by the board at a later date to reflect conversion of agricultural lands to nonagricultural use. FPA water is intended to serve as a supplemental, not a primary water supply for the region. Users who transfer any or all of their other water rights will not have the privilege of replacing these rights with FPA water (Thompson).

Each year the board makes a determination of how much water will be available for distribution to eligible project beneficiaries. It then contracts with each individual water user or water service organization in the conservancy district that wishes to buy the water. Nobody is required to buy project water. The unit price for FPA water is predetermined by the board and is the same for all users.

The governing board of the SCWCD exercises dominion over both the first rights to FPA water and to its return flows. No user has the right to sell project water to another user. Average return flows from the use of project water are estimated to equal 40 percent of the net amount of FPA project water available for delivery in any given year. Return flows are sold by the SCWCD for the same price as primary use water. They are available only to those individuals or water service organizations who are eligible to purchase FPA water in the first place. Most return flows are purchased by groundwater users in the district for their approved plans of augmentation. Both primary and return flows are sold by the district for $8 per acre-foot (Thompson).

The inflexibility of the FPA system of water allocation is somewhat offset by two storage programs offered through the project. The first

program allows users to store unused quantities of their FPA water in project storage facilities. Agricultural users may hold their unused water until May 1 of the following year, while M&I users may carry their unused water over from year to year. The carry-over program is limited by project reservoir space (Thompson).

The second program offered by the SCWCD allows agricultural users to store their decreed flow rights during the winter season for use in the summer. Whereas decreed flow rights in other areas of Colorado sometimes state a particular season of use for the right (typically April 1 to October 1), most direct flow rights in the Arkansas River basin are active all 12 months of the year. Large quantities of water that previously had to be released downstream unused may now be captured and stored. The district charges $3.20 per acre-foot of water stored, and the water may be stored until May 1 of the following year. Under the Winter Storage Program several cities and towns which have storage rights in their own privately owned reservoirs may also retain their direct flow rights for use later (Thompson).

Water allocated under the C-BT project was deeded directly to the individuals and the water service organizations within the project service area who expressed an interest in participating. The NCWCD retains all rights to the return flows of project water, but each water user has the full right to purchase, sell, trade, or rent their rights to the primary flows. Return flows from the C-BT are neither recaptured or resold, but are allowed to run on downstream freely. Since these waters cannot be formally appropriated, their effect has been to firm up the water supply available under native flow appropriations on the lower reaches of the South Platte River. Water users at the downstream end of the NCWCD have found little advantage in holding onto shares in a project which provides

them with water no matter what they choose to do, and have sold most if not all of their rights to upstream users. There are no carry-over or special storage privileges under the C-BT system (Conley).

The water rights to the C-BT are represented by 310,000 shares, or units. An annual fee to cover the fixed and operating costs of the project are assessed on each unit owned. The price for a C-BT unit, which was initially zero (they were issued freely to whoever signed up to participate in the project), is established by marketforces. The vast majority of C-BT units are held either by individuals for the purpose of irrigation, or by municipal or domestic water service organizations. A smaller number of miscellaneous units are held by collective irrigation organizations, nontaxable entities, and manufactoring concerns (Northern Colorado Water Conservancy District). Generally the only restriction on the ownership of C-BT units by individuals is that the units must be assigned (appurtenant to) a parcel of irrigable land. The NCWCD discourages excessive speculation in C-BT water by limiting the ownership of project units to only that quantity that may be put to beneficial use on the property or within the service area to which it is assigned. As a hedge against future growth and also against supply fluctuations, M&I and rural-domestic water service organizations are permitted to hold rights considerably in excess of their typical needs.

The Windy Gap Project was planned, organized and funded locally by the cities of Boulder, Estes Park, Fort Collins, Greeley, Longmont, and Loveland. Since its founding, Fort Collins has sold its direct interest in the project to the Platte River Power Authority while Estes Park has transferred some of xits interest to the city of Broomfield and to the Central Weld County Water District. Each participant in the project

assumes a proportionate share of the responsibility for the project costs and in return has the right to a proportionate share of the water supply available for delivery through the project. Each participant has total dominion over the water rights. They can use the primary flow and then reuse or sell the return flow to extinction, as long as it can continue to be identified. The service area for the Windy Gap Project, that is, the area within which Windy Gap primary and return flow rights can be used and/or marketed includes all of the NCWCD and some additional areas to the south (Zimbleman).

In summary, both Colorado state law and local water institutions play important roles in determining what types of water rights exist and which are available for sale and transfer. The nature of water rights can vary tremendously from region to region due to variations of the local management systems. Appendix B summarizes some of the principal water commodities available in the northeastern and southeastern regions of the state.

4. Water Market Activity

Water markets in northeastern and southeastern Colorado differ greatly in both their level and types of activity. Two important factors have influenced the formation and scope of the water markets and cause these differences. In northeastern Colorado willing buyers and sellers are often within the same water company service area, while those in southeastern Colorado are usually not. Users in northeastern Colorado can usually transfer transfer water rights quite easily by signing a stock certificate, but in southeastern Colorado nearly any major transfer requires formal water court proceedings to change the point of diversion and place of use of the water rights to a completely new area.

Northeastern Colorado has a very favorable institutional environment for allowing the transfer of large quantities of water rights over wide geographical areas. The single largest source of water in the area, the C-BT, is also the easiest type of water to transfer. The only source of water in southeastern Colorado which has been freely marketed over a wide area, Twin Lakes, represents a relatively small minority of the total available water resources available to users in the Arkansas basin. When Twin Lakes stock came on the open market several years ago almost all of it was quickly acquired by a few large buyers for their own use. Since then there have been virtually no shares of Twin Lakes stock offered on the market at any price.

Although water rights transfers have been observed in northeastern Colorado for many years, the existing market began to assume its present characteristics with the completion of the C-BT project in the late 1950's. It was not only the huge size of the project service area, which included five urban centers, several other small towns, and approximately 700,000 irrigated acres, that facilitated the formation of an active market for C-BT water. From the beginning the project was intended to provide water to agriculture, private homes, and commercial businesses in varying proportions over time. In order to ease the transfer of water rights from irrigation to M&I use, the appropriation decree permitting the transfer of water from the west slope to the east stipulated that C-BT water could be used for either irrigation or nonirrigation purposes. Municipal water service organizations and rural-domestic water companies have therefore been able to acquire C-BT units from irrigators without applying to the water courts for the right to change its point of diversion, place of use, and purpose of use. Moreover, they are free to rent any portion of their

unused C-BT water back to irrigation users without special authorization (Howe).

When the 310,000 C-BT units were initially distributed for a nominal fee in the 1950's, nearly 85 percent of all the water rights went to irrigated agriculture. Purchase records of municipal and rural-domestic water service organizations indicate that there was no established market price for C-BT water until around 1961 or 1962, when a number of units were sold for about $25 to $35 each. Assuming that each unit represents a long-term average yield of about 0.75 acre-feet, and adjusting the sums paid to 1984 constant dollars, the C-BT water market was clearing at an average real price of about $140 per acre-foot.

From the late 1950's and early 1960's to today, the transfer of C-BT units out of agriculture has continued gradually at a steady pace of about 1 to 2 percent per year. Currently the split of C-BT water rights between agricultural and nonagricultural users stands at about 60 percent and 40 percent, respectively. Price trends, however, have been much less even and predictable.

The price history of C-BT water is one of a steady initial rise followed by a few dramatic jumps to very high levels, followed by a decline to price levels lower than they had been for many years. From an average real price of about $140 per acre-foot in the early 1960's, C-BT water prices climbed to over $200 per acre-foot by 1963, $500 by 1966, $800 by 1979, over $1000 by 1974, $2000 by 1977, and $4000 by late in 1979, when average prices peaked and began a rapid decline. By 1981 prices had fallen to about $3000 per acre-foot, then to below $2000 in the following year and to $1000 by the middle of 1985, approximately the same price that the water rights had sold for a decade earlier.

Shares of stock in the North Poudre Irrigation Company are considered by many in northeastern Colorado to be one of the most marketable water rights in the NCWCD after the C-BT. The company's issue of 10,000 shares of stock is held by a variety of municipal and industrial, rural-domestic, and agricultural water users within a service area covering much of the northern portion of the NCWCD. The long-term average yield on each share of stock is just under 6 acre-feet per year. Stockholders may split their shares up into quarter-shares representing an average yield of about 1.5 acre-feet per year in order to buy and sell smaller quantities of rights. There were a total of 9,926 shares of stock in general circulation in 1984. North Poudre delivers an average total of about nearly 60,000 acre-feet of water per year. The company's water inventory includes 40,000 units of C-BT water, a mixture of junior and senior flow rights averaging over 15,000 acre-feet per year, and over 25,000 acre-feet of reservoir water rights (North Poudre).

Large and reliable water supplies available over an extensive geographical area, a large number of shares of stock, and the small quantity one-quarter shares make North Poudre water stock an extremely marketable commodity similar in nature to C-BT water rights. Typical prices for North Poudre stock have tracked the historical movement of C-BT prices. On an acre-foot basis, they generally sell for between 60 percent and 70 percent of the going market price for C-BT units.

Comparable acre-foot quantities of other water rights within the NCWCD typically sell for 50 percent, 35 percent, or even less than 20 percent of the market value of C-BT water. These are water rights that tend to be less transferable. Some are available for use by only a relatively small number of potential buyers within a limited geographical area. Some provide water that currently remains limited to agricultural use, and their

transfer to a nonirrigation use would require potentially expensive legal proceedings. Some of these alternative water supplies are either not reliable or are not available in a form useful to the buyer. Most of the adjudications for irrigation rights in northeastern Colorado restrict use to only certain days of the year. Many irrigation water rights cannot legally be called upon for more than a few months during the spring and summer. Municipal and rural-domestic water suppliers, whose customers demand steady supplies of water all months of the year, have a limited demand for these highly seasonal water rights (Menzel).

The less flexible ditch rights, privately adjudicated water rights, small private reservoirs and groundwater rights are rarely sold apart from the land to which they are deeded. Most often these water rights are retained for agricultural use and their market values are low (Harrison).

Windy Gap water has the potential to become one of the most flexible and marketable water resources in northeastern Colorado. The realization in the early 1980's that Windy Gap would soon be a reality is reputed to be one of the major reasons for the sudden turnaround in skyrocketing water rights prices.

There are two main barriers to buying and selling primary rights to Windy Gap water at the present time--the high cost of water rights and the system of ownership. As a privately financed water project, Windy Gap is the most expensive source of primary water rights in the area. The current annual cost to project participants, including bond debt service and operation and maintenance costs, is between $200 and $300 per acre-foot. Participants in the project hold prorated shares of bonded indebtedness in proportion to their entitlement to the water. The sale of primary Windy

Gap water necessitates the transfer of an equal share of the bonded indebtedness, which can be a very complex transaction (Harrison).

Few transfers of the primary water rights in the Windy Gap project have taken place thus far. The best examples are two sales by the town of Estes Park. In the summer of 1985 they sold an interest in 100 acre-feet per year to the Central Weld County water district for $50,000, or $500 per acre-foot. In the fall of 1985 Estes Park concluded another agreement to sell 3,700 acre-feet of primary Windy Gap rights to the city of Broomfield for $1.5 million, or slightly more than $400 per acre-foot (Hill).

Interest in the Windy Gap project remains strong despite the high cost of the water relative to the current market price for other supplies in northeastern Colorado. The advantages of Windy Gap water relate to the fact that users have complete ownership of the water, including all return flows. Project participants expect that recycling of Windy Gap water (by selling return flow to a downstream user and by applying it to water exchanges and well augmentation) will generate sufficient returns to make the initial water costs worthwhile (Hollar). Since Windy Gap is operated jointly with the C-BT and they share a common service area (the service area for Windy Gap is actually larger than the NCWCD), it will have many of the same market advantages that C-BT water has.

While the share of water rights held by irrigation and nonirrigation users in northeastern Colorado have changed considerably over the past twenty five to thirty years, the patterns of actual water use have not changed proportionally. Water rights purchased from agriculture are rented back to irrigators in large quantities every year. Municipal and rural-domestic water service organizations maintain large inventories of water rights in order to protect their users against fluctuations in supply.

Less than half of the C-BT units owned by nonagricultural water users, for example, have actually been drawn upon in most years. Since the NCWCD does not carry over unused water rights to subsequent years, there is an incentive for shareholders to at least cover the costs of the assessment on the units by renting the water. Almost the only buyer for rental water in the district is irrigated agriculture, although a few nonagricultural water service organizations have rented water (Howe).

The rental market for C-BT and other types of water rights in northeastern Colorado exhibits none of the price trends observed in the purchase and sales of the rights themselves. Prices have been low, and in real terms have declined over time. Nominal rental prices for C-BT water slowly rose from between $3 and $5 per acre-foot in 1969 to between $5 and $10 per acre-foot in 1979 to between $10 to $20 per acre-foot in 1984. Rental prices for other water rights available in 1984 and 1985 vary between about $5 and $20 per acre-foot. Since water supplies have been ample in both years, large quantities went unrented.

With the development of the Windy Gap project and with urbanization continuing in the NCWCD, it does not appear that the market for rental water will tighten in the foreeable future. More and more water rights have been acquired or developed by M&I and rural-domestic organizations and rented to agricultural users, who are using less and less water over time. Even in relatively dry years and at prices only slightly above the cost of the annual assessment for their water rights, rights-holders frequently fail to find renters for all of their surplus water.

Market Activity in Southeastern Colorado

Activity in the southeastern Colorado water market is both simpler and more difficult to describe than in northeastern Colorado. It is simpler

because there has been much less of it. It is more difficult because most of the important water rights transfers have necessitated extensive negotiations and litigation. Only one particular water commodity, Twin Lakes stock is discussed in detail below. Other water commodities are discussed more generally. The market activity of some major market actors in the basin is summarized.

Over a dozen different transmountain diversion projects bring some 200,000 acre-feet of water per year into the Arkansas River basin. Only the 50,000 acre-feet of water provided through the Twin Lakes Reservoir and Canal Company has ever been marketed. Nearly all of the Twin Lakes stock came onto the market and was sold within a period of about five or six years in the 1970's. Only a very few shares have been resold since then.

The 45,000 shares of outstanding stock in the Twin Lakes company were all originally owned by farmers within the service area of the Colorado Canal Company, about 50 miles east and downstream of the city of Pueblo along the Arkansas River. Two other water service organizations located in the same general area are the Henry and Meredith reservoir companies. The four irrigation companies provide three different types of water rights--transountain diversion and native flow water from Twin Lakes, native flow rights through the Colorado Canal, and reservoir rights from Henry and Meredith lakes. Most farmers owned stock in all four water companies and had their water delivered to them through the Colorado Canal system (Miles).

Until 1970, farmland in the Colorado Canal company service area sold for around $200 per acre, including all land and water rights. Around 1970 an investment group called the Crowley Land and Development Company (CLADCO) offered farmers in the area about $370 per acre ($1,000 per acre

in 1984 constant dollars). Most farmers jumped at the chance and, despite heated local opposition, sold a majority of their land and stock in each of the companies to CLADCO. Slightly over 60 percent of the Twin Lakes stock changed hands. Much of the remaining stock in the Colorado Canal Company was bought up by a consortium of stockholders called the Proxy Group (Miles).

CLADCO and the Proxy Group successfully obtained a decree in water court changing the purpose of use for Twin Lakes water rights from irrigation to multiple use. Since Twin Lakes stock represented primarily transmountain diversion water rights, it suddenly became very valuable and marketable to nonagricultural users in the Arkansas River basin. The status of the native flow and reservoir water rights which were appurtenant to lands in the Colorado Canal service area were not affected by this decision.

Between 1972 and 1975 CLADCO and the Proxy Group each sold large packages of Twin Lakes water stock to the cities of Pueblo, Pueblo West, and Colorado Springs for prices ranging from about $1,000 to $1,100 per share. Adjusted to reflect 1984 constant dollar prices on an acre-foot basis, the cities paid between $2,400 to $2,600 per acre-foot. In 1976 another lot of Twin Lakes stock that had been transferred from CLADCO to the Aetna Group was sold in turn to the city of Colorado Springs for slightly over $2,300 per acre-foot (1984 constant dollars). Only six sales of Twin Lakes stock by CLADCO, Aetna, and the Proxy Group (one to Pueblo West in 1972, two to Pueblo in 1972 and 1973, and three to Colorado Springs in 1972 and 1976) accounted for the transfer of nearly all of the Twin Lakes water rights in existence.

There were some other transfers of Twin Lakes stock to the cities during this same period. Pueblo West bought a farm with 237 shares of Twin

Lakes stock 1971, for about $1,400 per acre (1984 constant dollars), including all land, improvements, and water rights. The farm is still in operation and is continuing to use the water rights until Pueblo West wants them. Pueblo West acquired another 114-acre farm from the McCulloch corporation in return for unspecified compensation to the developer. Colorado Springs bought a total of approximately 500 acre-feet from miscellaneous owners during the summer of 1976 for an average price of $2,065 per acre-foot (1984 constant dollars). Finally, Aurora acquired approximately 2,000 shares of Twin Lakes stock in the mid-1970's for prices ranging between roughly $3,000 and $10,000 per share. Aurora, which is located in the South Platte River basin, won a court decree changing the trans-mountain diversion portion of the water rights from out of the Arkansas River basin to the South Platte. They have not yet attempted to transfer the native flow portion of the water rights.

No specific price information is available on the sale of other shares of Twin Lakes stock. Very small quantities have been sold to homeowners in mountain resort communities in order to meet their legal requirements for groundwater augmentation plans. Rather than purchase less expensive but less flexible native stream rights involving water court transfer procedings, some individuals have purchased shares of Twin Lakes stock for prices ranging from $6,000 to $10,000 per share (Miles).

Until the completion of the main portions of the Frying Pan-Arkansas Project in the late 1960's, there were relatively few transfers of water rights in southeastern Colorado. The overwhelming majority of water market activity involved local transfers of water rights (usually with land) from one farmer to another. The major exception was the CF&I Steel Corporation, which steadily acquired small parcels of water rights in the

Arkansas basin from the end of the 19th century until shortly before World War II. The transfers were small and local, and met with little or no opposition. Many of the transfers actually benefitted the remaining agricultural users in the area, since since CF&I's consumptive use of the water was less than irrigation consumptive use. Local return flows tended to increase as a result of the transfers (Mahanney).

Four municipal water service organizations in the Arkansas River basin, the cities of Colorado Springs, Fountain, Pueblo, and Pueblo West, have purchased most of the water rights that have been transferred out of agriculture. A fifth major buyer located outside of the Arkansas River basin, the city of Aurora, is currently attempting to enter the market with a single large transaction. Most of these transfers taken place within the last twenty years, and they have become increasingly sophisticated, controversial, and expensive.

Colorado Springs has made two major purchases of water rights--the previously-described acquisitions of stock in the Twin Lakes company and storage space in Tourquoise Reservoir. Recently it concluded a third transfer, an agreement to purchase a considerable quantity of direct flow and storage rights in the Colorado Canal Company. These purchases are in addition to several smaller acquisitions of water rights from ranches, and to the extensive water rights it has acquired by virtue of the Frying Pan-Arkansas, Homestake, and Blue River transmountain diversion projects. Colorado Springs has several thousand acre-feet of additional undeveloped water rights appropriated on the west slope which it proposes to use for expansions of the Homestake and Blue River projects, and the construction of a new project, the Eagle-Arkansas. Finally, the city is continuing to expand its system of recycling, marketing, or exchanging the legally reusable portions of its return flow (Concer).

Tourquoise Reservoir, located at the headwaters of the Arkansas River just east of the continental divide, was an expansion by the Bureau of Reclamation of CF&I's old Sugarloaf Reservoir as part of the Frying Pan-Arkansas Project. CF&I sold its rights to space in Tourquoise Reservoir to the cities of Aurora, Colorado Springs, and Pueblo. Colorado Springs purchased 17,470 acre-feet of the storage rights, plus direct flow rights totalling another 4,200 acre-feet in May, 1984 for $8.3 million (Mahanney). The city purchased the package of rights primarily for the storage space, which it can utilize for several different purposes. Tourquoise Reservoir is used by Colorado Springs both to deliver Homestake Project water to the city, and to transfer water rights upstream from Pueblo Reservoir. The direct flow rights they acquired in the purchase, most of which are too junior to be of much value, were considered incidental to the acquisition of the reservoir storage space (Concer).

In the spring of 1985 Colorado Springs concluded negotiations on the purchase of a large package of land, improvements, and stock in the Henry and Meredith reservoirs and the Colorado Canal Company. The seller, Foxley and Company, had obtained the property from CLADCO after that group sold off its stock in the Twin Lakes company. The land and the works and improvements were sold for $5 million. The water rights were sold for $1,300 per acre-foot of water transferable to Colorado Springs. It is expected that approximately 14,000 acre-feet per year will be available. The total cost for the deliverable water rights is therefore about $1,650 per acre-foot (Concer).

Concurrent with the Foxley transaction, some minority stockholders in the reservoir and canal companies have also offered their water rights to

Colorado Springs. In mid-1985 the city was still considering whether it would like to buy these rights, and at what price (Concer).

As with the Tourquoise Reservoir, Henry and Meredith water rights have value to Colorado Springs not only for the deliverable quantities of water but also for the reservoir storage space. Colorado Springs may store unused water from their portfollio of rights in the Henry and Meredith reservoirs should there ever be insufficient storage capacity in Pueblo Reservoir. Later, they could release water from the reservoirs to serve downstream users, in exchange for water upstream in the Pueblo Reservoir (Concer).

Until recently, Colorado Springs did not do very much with its legally reusable return flow water. A small portion of the water has been marketed to downstream users for their groundwater augmentation plans. The price charged for the sale of return flow is currently about $235 per acre-foot. In 1986 the price will be increased to about $260 per acre-foot. Additional small quantities of return flow have been used for urban irrigation. Most of the water, however, was simply released into the Fountain River, where it flowed downstream to mingle with the Arkansas.

Within the past year Colorado Springs has begun ambitious efforts to reclaim all of its legally reusable return flow. The city has vastly expanded its reuse of return flow by winning a temporary (conditional upon the hearing of all arguments and the issuance of a final decree) right to substitute 34,000 acre-feet of return flow per year for Pueblo Reservoir release. Depending upon the outcome of this return flow court case Colorado Springs anticipates reclaiming up to another 30,000 acre-feet of return-flow water through similar exchange programs. It is not known how much, if any, of the reclaimed return flow may eventually be marketed to other water users (Concer).

The city of Fountain, a small town located 10 miles south of Colorado Springs, used to maintain the Mountain Reservoir as its sole water supply, but was forced to seek an alternative source when state health authorities ordered expensive renovations in the water treatment system. First it considered purchasing a groundwater wellfield about 20 miles to the east in the Black Squirrel Basin, but local opposition successfully blocked the sale. Fountain then developed its own wellfield in the mid to late 1960's. With the closing of the area to further groundwater appropriations and the passage of legislation require groundwater augmentation plans, Fountain had to acquire additional water rights to compensate for its groundwater pumping. Part of its obligation is met by releasing water from the Mountain Reservoir. The rest is met through the retirement of water rights associated with Fountain Valley Mutual Irrigation Company water stock, which Fountain has been purchasing gradually for several years. Fountain's acquisition of Fountain Valley Mutual stock bypasses the need for water court proceedings, because the town is located within the service area of the water company. According to the city manager there is a market for Fountain Mutual stock, since the town is not the only potential buyer (Bustamento).

With the completion of the Fountain Valley pipeline, Fountain began receiving water from the Frying Pan-Arkansas Project in 1985. It may purchase FPA water for use in its system directly, or it may choose to purchase FPA return flow to support its groundwater augmentation plans. One other source of supplemental water available to Fountain is the acquisition of additional groundwater rights and pumping facilities. Recently they considered buying some groundwater southeast of town, but

have taken no action because the water quality is not good and the asking price for the rights are much too high.

The city of Pueblo is located along the Arkansas River just below Pueblo Reservoir, about 30 miles east of the front range. In addition to its participation in the Frying Pan-Arkansas Project and its acquisition of stock in the Twin Lakes company, it has purchased a number of shares of stock in other ditch companies and has constructed some water development projects of its own. Pueblo's principal water company acquisitions in recent years have been the purchase of storage rights in the Otero Canal Company, the Booth-Orchard Canal Company, storage and flow rights in the Rocky Ford Highline Canal Company (O'Hara).

Pueblo also bought storage rights in Tourquoise Reservoir from CF&I Steel Corporation in December, 1983. They paid CF&I $2 million for 5,000 acrefeet of storage rights. In June of 1967, Pueblo paid the city of Aurora $1,000 ($3,125 in constant 1984 dollars) per acre-foot for a perpetual right to lease up to 2,500 acre-feet of water per year from Aurora's share of the Homestake Project. The rental price is fixed at $3 per acre-foot of water delivered.

Pueblo offers its unused water each year for lease. Only reservoir and transmountain diversion water rights are rented. Direct flow rights are not rented because their seasonal transfer to another user would require a change application with the water courts, a costly and time-consuming procedure. Pueblo's Twin Lakes water is the only water they lease at a predetermined price, which was $18 per acrefoot through 1984. A recent surplus of rental water on the market has forced Pueblo to reduce its asking price to $10 per acrefoot. Other water rental prices are determined on the basis of closed bids. Pueblo and Pueblo West, which also rents water each year, trade information with each other on the bids they

have received from prospective buyers. Pueblo generally sets a floor on its rental prices and will not offer water below that minimum price, even if they are consequently left with large quantities of unrented water. The city of Aurora regularly pays Pueblo a unit price equal to the highest bid received by Pueblo for its water that year, for leasing Twin Lakes water (O'Hara).

Pueblo West, a resort community located several miles west of the city of Pueblo near the base of the front range, was created by private developer in the 1960's. Since the community was not included within the boundaries of the SCWCD, and since Pueblo would not agree to provide them with water service, Pueblo West was forced to develop its own water supply. It began in the 1960's by drilling several groundwater wells. Most of the wells drew poor quality water, and the potable water available from the wells was not sufficient to support a community of any size. Pueblo West purchased shares of Twin Lakes water stock in the early 1970's and negotiated an agreement with the SCWCD to store the water in Pueblo Reservoir. Pueblo West now owns enough water rights to service a town ten times its current size. Each year the extra water is made available to whoever wants to lease it. The rental prices are determined through closed bids. Real prices since 1982 have varied from as little as $2.70 per acre-foot to as much as $31.25 per acre-foot. Pueblo West has never succeeded in renting out all of its unused water rights. Since 1982, it has never rented more than 1,680 acre-feet and has rented as few as only 331 acre-feet (Zamecki).

The city of Aurora is located just east of the Denver in the South Platte River basin. As the fastestgrowing metropolitan center in Colorado and the largest next to Denver, Aurora has a long history of water rights

acquisitions and water development projects affecting both the South Platte and Arkansas River basins. Aurora's first involvement with the Arkansas River basin came in the 1960's when it cooperated with the city of Colorado Springs in developing the Homestake transmountain diversion project, and subsequently sold 2,500 acrefeet of rights to its share of project water to the city of Pueblo. In 1973 Aurora purchased a total of 2,500 shares of stock in the Twin Lakes company for $1,150 ($2,675 in 1984 dollars) per share. In January, 1984, Aurora purchased 5,000 acrefeet of storage space in Tourquoise Reservoir from CF&I Steel Corporation for $2 million.

The most recent and perhaps the most controversial water transfer case now before the water courts involves a proposed acquisition by Aurora of a substantial portion of the Rocky Ford Ditch Company. The bulk of the shares offered for sale are owned by the Resource Investment Group, which owns 53 percent of the Rocky Ford Ditch. Another 5.8 percent of the stock in the company, also included in the deal, is being offered by a group of minority stockholders. The agreement calls for the purchase of up to 10,000 acrefeet of transferable (that is, consumptive use) rights. Aurora has agreed to pay $2,200 per acrefoot for the first 5,000 acrefeet, and retain an option to purchase an additional 5,000 acrefeet for $2,300 per acrefoot. Included in the contract is a provision giving the Resource Investment Group the first right of refusal to lease any unused portion of the water rights back from Aurora for farming in the Rocky Ford area (Spenser).

The transfer is highly controversial because the water rights would not only be transferred out of the canal company service area, but completely out of the basin. Aurora proposes to make an exchange between Rocky Ford water and Pueblo Reservoir releases, and then move the water on to Aurora via either an exchange through Tourquoise Reservoir or a direct

pipeline. Local opposition to the plans has been heated. Few expect the case to be resolved soon.

Other large blocks of water rights are currently being offered for sale in the Arkansas River basin, but it is uncertain whether there will be any ready buyers for them. These include 10,000 shares of the Bessamer Ditch Company, which yields about 3 acre-feet per share and is being offered at $6,000 per share ($2,000 per acre-foot). Previous to this offer, the stock had been selling among irrigators for around $1,200 to $1,500 per share ($400 to $500 per acre-foot). Another large block of water rights listed for sale in mid-1985 is the entire outstanding stock in the Huerfono-Cuchares Ditch Company, for $13 million. The company's water inventory includes about 6,800 acre-feet of flow rights and a reservoir with a capacity of 64,000 acre-feet, which is in need of repair and can hold only about 35,000 acre-feet. In neither case is it clear how much of the water rights have been consumptively used and are therefore potentially available for transfer (Beamon).

Even if a deal to buy one of these blocks of water rights could be worked out, there is no guarantee that that the water court would approve the proposed transfer. Prospective buyers of water rights in the Arkansas basin are have not forgotten of the disasterous purchase of water rights by the Colorado Game and Fish Commission in 1971. Up until that time, shares of stock in the Catlin Canal Companyg (each with a long-term average yield of 4 acre-feet per year) had been selling for about $160. The Game and Fish Commission bought 2,097 shares in the company for $500 each ($320.50 per acre-foot, in 1984 dollars), intending to tranfer the water rights to a large reservoir along the river for the purposes of fish and wildlife habitat. The remaining stockholders in the Catlin Canal Company

successfully opposed the transfer, arguing that their water rights would be impaired. The Fish and Game Commission appealed the decision, but opposition to the transfer was eventually upheld by the state supreme court. Over $2.5 million (in 1984 dollars, not including court costs) was paid for water rights that could not be used for the purpose the buyer had intended (Milenski).

C. WATER MARKETS IN THE TRUCKEE RIVER BASIN, NEVADA

1. General Description of the Study Area

The market area chosen for study in Nevada includes the Truckee River basin and adjacent areas in southern Washoe County, Story County, and parts of Churchill and Lyon counties. Most of the area's population of 250,000 is concentrated in and around the cities of Reno and Sparks, which are located in a valley known as the Truckee Meadows. The Meadows are flanked on the west by the Sierra Mountains and on the east by the Great Basin. Most agricultural activity is concentrated in the Newlands Project, located about 50 miles east of the Truckee Meadows. The Newlands Project, which is managed by the Truckee-Carson Irrigation District (TCID), was one of the first projects built by the Bureau of Reclamation in the early 1900's.

The Truckee is one of the shortest major river systems in the country. Its begins at Lake Tahoe in the California Sierras, crosses the state line into Nevada and flows east past irrigated farms and ranchlands surrounding the metropolitan centers of Reno and Sparks in the Truckee Meadows until it approaches the western edge of the TCID near the town of Fernley. From the edge of TCID the river turns north for less than 20 miles before emptying into Pyramid Lake in the Pyramid Lake Indian Reservation. The entire distance that the river covers on its meandering journey from the state line to its terminus in Pyramid Lake barely exceeds 75 miles.

Nevada is the driest and one of the fastest-growing states in the U.S. Reno and Sparks are growing centers of tourism and commerce and their populations are expanding rapidly, placing increasing pressure on the region's limited water resources. Rights to Truckee River water are highly controversial. Conflicts among the cities, the Pyramid Lake Indians, fish and wildlife managers, and irrigated agriculture have continued unabated for the better part of the 20th century.

An average of 650,000 acre-feet of Truckee River water is used per year in Nevada, including all return flows. Roughly 50,000 acre-feet is used for municipal and industrial purposes in the Truckee Meadows, while 300,000 acre-feet is used for irrigation. Irrigation uses are divided among farms in the TCID (190,000 acre-feet), farms on the Pyramid Lake Indian Reservation (about 5,000 acre-feet), and other farms and ranches (about 105,000 acre-feet). About 300,000 acre-feet of Truckee River water flow into Pyramid Lake (Stone). Consumptive use of the water rights along the Truckee River has risen over time and, as a result, the quantity of water emptying into Pyramid Lake has declined. Falling lake levels have alarmed sportsmen, conservationists, and especially the Pyramid Lake Indians, who have actively advocated measures for providing additional water to stabilize the lake (McNeeley).

An average total of 375,000 acre-feet of water are used by TCID from rights developed on the Truckee River and the Carson River, which flows parallel to the Truckee 20 miles to the south. Water taken from the Truckee River by TCID is carried by the Truckee Canal into Lahontan Reservoir, where it mingles with roughly an equal quantity of water from the Carson River prior to its distribution over TCID's 75,000 irrigated acres. By a joint agreement between the TCID, the state of Nevada, and the U.S. Fish and Wildlife Service, return flows from the Newlands Project are allowed to dissipate in marshlands to the east of the TCID to support the Stillwater Wildlife Refuge.

Approximately 10,000 acre-feet of groundwater are used for M&I purposes in the cities of Reno and Sparks. A small number of domestic users in the Truckee Meadows area outside of Reno and Sparks and a few irrigators use another 2,000 to 3,000 acre-feet per year. Relatively little groundwater

has been used because of the low cost of using Truckee River water, because the state engineer discourages its use, and because the quality of ground water is highly variable. Groundwater quality can be very poor in the southern and eastern portions of the Truckee Meadows due to the presence of heavy metals. In some locations the water is so poor that it cannot be used unless it is mixed with cleaner water from the Truckee River. There is a danger that poor quality water could be drawn into the more potable aquifers and groundwater withdrawals in the Truckee Meadows are carefully regulated by the state engineer (Firth).

Water marketing in the area of the Truckee River basin has been confined largely to the Truckee Meadows. A small number of groundwater rights transfers have been recorded in some nearby valleys. Intraregional or interregional water transfers involving the TCID, the Pyramid Lake Indians, and the Stillwater Wildlife Management Area are either illegal, extremely difficult, or for one reason or another have not yet been attempted. These areas are nevertheless included in the study because the management of their water resources continues to have a significant impact on the availablility of water supplies in the Truckee Meadows market.

Market conditions for trading water rights in the Truckee Meadows are fairly good, although transactions costs may be quite high. All of the basic criteria for selecting a water market study area were met. Water rights have been bought and sold regularly since at least 1945, and the level of activity has been sustained throughout. Water rights are scarce relative to demand and prices are high in the Truckee Meadows and throughout the entire area except in the TCID. Surface water supplies are not available for appropriation anywhere in the region. In 1978 the state engineer declared the Truckee Meadows a designated groundwater basin and closed the area to further appropriation. Some additional storage space

may be created along the Truckee River system in the future, but no large interbasin water transfer projects are planned. Limited quantities of groundwater may still be available for appropriation in the TCID and in some other more remote areas (Walstrom).

Municipal and industrial customers in the Reno-Sparks area receive gas, water, and electrical service from the Sierra Pacific Power Company, a privately owned utility. The Washoe County Public Works Department provides some water service to outlying communities in the Reno-Sparks area. A few communities have been serviced by private water companies, several of which have been taken over recently by Washoe County. Irrigators hold individual decrees for water in the Truckee River, which is distributed by private ditch companies.

A number of ditch companies once provided Truckee River water to irrigators in the Truckee Meadows. Many of these companies are now inactive because their service areas and/or their water rights have been transferred to Sierra Pacific. Most water is treated and delivered to municipal and industrial users through Sierra Pacific's system. Lake Tahoe and Boca Reservoir serve as area-wide regulatory and storage facilities for the Truckee River. In addition, Sierra Pacific operates two small privately owned reservoirs, Donner and Independence Lakes. A third facility, Stampede Reservoir, was originally developed by the Bureau of Reclamation as a multi-purpose, supplemental water supply. The water supply has since been used to support fish habitat, and has never been made available for M&I use. Sierra Pacific is attempting to work out a compromise with the federal goverment so that some of this water may be made available to the company (Firth).

2. Research Activity in the Study Area

Site visits were conducted during the spring of 1985 in order to interview market actors and collect data on market transactions. Investigations concentrated on the Truckee Meadows area market, but inquiries were also made into market activities in adjacent groundwater basins and in the TCID. Unfortunately, no individual or entity maintained comprehensive records on water market transactions. Data, especially on recent market transactions (those which took place since 1979), were difficult to identify and collect.

Interviews were conducted with numerous representatives from federal, state, and local government agencies. These included the offices of the federal watermaster, the state engineer, the cities of Reno and Sparks, Washoe County, the state senate, and the Public Service Commission. Representatives interviewed from the private sector included lawyers, engineers, real estate developers, Sierra Pacific Power Company, and the regional homebuilders association.

Secondary materials on the Truckee River basin water market were extremely limited. One dated publication from the University of Nevada and a preliminary water resource planning report issued by Sierra Pacific were virtually all that was available.

3. Water Rights Laws and Institutions

Nevada is one of the few states which recognizes the appropriation doctrine exclusively for the administration of both groundwater and surface water, and it has done so for several decades. The office of the state engineer was created in 1903 with the passage of Nevada's first comprehensive water law. The primary purpose of this act was to provide a method by which the existing rights to appropriated water might be defined,

regulated, and protected. Relatively few changes in the basic water laws have occurred since 1939, when legislation was passed which declared that all groundwaters that had not hitherto been subject to the appropriation doctrine were explicitly included. Small domestic wells were exempted from regulation.

The general policy of Nevada towards groundwater has been to restrict withdrawals from a given basin to hydrologic safe yield (Chalmers). Under exceptional circumstances the state engineer may issue temporary and revocable authorization to mine a groundwater aquifer until an alternative source of water can be developed. The Las Vegas basin is the only designated groundwater basin in Nevada in which groundwater overdraft has been sanctioned in anticipation of the development of the state's allotment of Colorado River water (Ohrenschall).

In the 1960's Sierra Pacific began developing groundwater rights in the Truckee Meadows to supplement its surface water rights on the Truckee River during periods of peak demand. Rights to the amount of 48,000 acre-feet per year have been appropriated, but this is far in excess of hydrologic safe yield in the area. The state engineer and Sierra Pacific have agreed to maintain groundwater pumping at 8,000 to 10,000 acre-feet per year, while permitting as much as 12,000 acre-feet to be withdrawn under short-term critical conditions (Moser).

The state engineer has primary responsibility for distribution of all water in Nevada except federally decreed stream systems, which are administered by a watermaster appointed by the federal district court. The federal watermaster distributes water according to the priority dates of the water rights, or according to established operating criteria for the stream system. Water is diverted from the main stream under the watermaster's supervision into ditches owned by water companies. The water

companies then provide their own distribution among the individual users of the company ditch.

The Truckee River is a federally decreed stream administered by a federal watermaster under the Orr Ditch Decree of 1944. About 29,000 acre-feet of water per year were allocated to the Sierra Pacific Power Company, over 230,000 acre-feet per year for the Newlands Project (TCID), and 177,000 acre-feet per year for irrigation on other lands. Another 30,000 acre-feet per year were designated for irrigated agriculture on the Pyramid Lake Indian Reservation (Orr Ditch Decree). No more than 5,000 acre-feet per year of this right has ever been used. The Sierra Valley Water Decree of 1958 confirmed the right of the Sierra Valley Water Company of California to divert an average of 10,000 acre-feet per year from the Little Truckee River. The Sierra Valley Decree states that the rights are subject to the Orr Ditch Decree and are to be administered by the federal watermaster as part of the Truckee River system (Moser).

No water was allocated under the Orr Ditch Decree specifically for the purpose of maintaining the level of Pyramid Lake or streamflows in the Truckee River itself. The Pyramid Lake Indians, who derive much of their livelihood from fishing the lakes and rivers, have strongly contested this omission. In recent years the Endangered Species Act has been successfully invoked by the Indians to win some concessions in their battle to protect essential lake and stream habit for two endangered species of fish, the Cui-Cui and the Lahontan Cut-Throat trout.

Although water rights under the Orr Ditch decree were assigned on the basis of prior appropriation, water is generally distributed on a prorated basis. Minimum levels of flow in the river at selected gaging points along the stream are proscribed according to operating criteria set forth in the

Truckee River Agreement of 1935 (Stone). The operating criteria provide for the servicing of all appropriations on the river and for the proration of all claims in the event of insufficient water supplies. Modified operating criteria are also proscribed drought conditions. Only if hydrologic conditions were severely below normal, as occurred in the 1930's and once again for a brief period in the late 1970's, would the operating criteria fail and a system of relative priorities have to be enforced instead. Under extreme conditions, the 29,000 acre-feet of water rights assigned to Sierra Pacific have priority over all irrigation rights and would be the last ones cut back (McNeeley).

The operating criteria for the Truckee River have been the focus of continuing controversy for many years. While the Pyramid Lake Indians and various conservation interests clamor for more water to support fish and wildlife habitat, the TCID and Sierra Pacific are seeking ways to maintain and increase their current levels of use. Lack of knowledge about the hydrologic system has exacerbated the conflicts and prevented any permanent resolution. It has never been known with any degree of certainty what the hydrologic limitations of the river are, and how flexible the system could be in adapting to changing demands. As a result, meaningful negotiations among the various interest groups have been virtually impossible. Recently Sierra Pacific hired an engineering consultant to develop a highly sophisticated hydrologic model of the Truckee River basin. Although all sides have now agreed on the authenticity of the model for planning purposes, maneuvering continues over the choice of priorities and objectives in operating the system.

Changes in the point of diversion, place or purpose of use of any groundwater or surface water right in Nevada, including those on federally decreed streams, are processed through the state engineer's office. A

water right is considered a property right and is protected as such. When water rights are granted they are appurtenant to a given piece of land for a specific purpose. Generally, when land is sold all water rights appurtenant to the property described in the deed automatically transfer to the new owner. Application to the state engineer may be made, however to sever the water right from the land and reassign it elsewhere.

Guidelines regulating the transfers of water rights in Nevada are few. The primary condition is that the transfer does not impair existing water rights or otherwise appear detrimental to the public interest. In addition, holders of surface water rights do not have the option to change the point of diversion to a groundwater well, or to change the point of diversion of a groundwater right to a surface water source (Westergard).

In a federally adjudictated stream system such as the Truckee River, the state engineer consults with the federal watermaster on the feasibility of administering transfers of water rights in the system under the directives of the federal decree. Water rights transferred on the Truckee River have not been limited to the consumptive use portion of the right. As long as the transfer is compatible with the operating criteria for the river, it may be approved. Temporary water rights transfers (leases) have generally not been permitted. The federal watermaster of the Truckee River has long been opposed to them for the reason that they would overly complicate administration of the river (Stone).

IV. Water Market Activity

Water rights in four diffreent sub-areas in the Truckee River basin area include surface water rights in the Pyramid Lake Indian Reservation, groundwater rights outside of the service area of Sierra Pacific, surface water rights in the TCID, and groundwater and surface water rights

available for transfer to the service area of Sierra Pacific in the Truckee Meadows. Until now these areas have been isolated from each other and all observed water rights transfers have taken place within subareas. There is no indication that significant water rights transfers between these subareas will be attempted or permitted in the foreseeable future.

No water market activity has occurred within the Pyramid Lake Indian reservation. They are unlikely to enter the marketplace because they have had some succes in securing water rights through nonmarket strategies. Furthermore, the quantity of water they would have to buy to materially influence the level of Pyramid Lake is tremendous and would take a considerable sum of money, even if the water were legally transferable and a sufficient number of willing sellers existed. In resorting to nonmarket water transfer strategies the Indians have been able to effectively gain access to water although at this point the water rights are neither formally appropriated nor permitted by the state engineer.

The Indians have won concessions on two fronts, and in both cases their victories have had an impact on the water rights available for other users along the system. Their first success was Stampede Reservoir, built by the Bureau of Reclamation on the California side of the state line in 1970 to aid in regulating the flow of the Truckee River. Stampede was orginally conceived of as a multi-purpose water project, but no water has ever been diverted from it for either irrigation or M&I uses, even though Sierra Pacific Power Company had counted on a substantial allocation of water from the reservoir. Since the early 1970's, the federal government has allocated all the water in the reservoir to help maintain the level of flow and the temperature of the Truckee River for fish habitat. The reservoir will continue to be used for this purpose so long as the native

trout species in the Truckee River and in Pyramid Lake are considered endangered. Appeals filed in federal court by Nevada state officials have thus far been unsuccessful. Another success for the Indians is a change in the operating criteria for the Truckee River system, which was initiated in 1985. Water supplies released for irrigation purposes both inside and outside of the TCID have been reduced by up to several tens of thousands of acre-feet per year. Conservation requirements for reducing evaporation and seepage losses are being enforced.

Nonagricultural water users located outside of the existing or planned service area of Sierra Pacific have generally had to rely on local groundwater supplies to meet their water demands. Since the basins in northwestern Nevada are closed to additional appropriation, and since exempt groundwater wells are too small and inadequate for most purposes, new water users have had little choice but to acquire water rights from existing users. In some isolated groundwater basins where development pressures are strong, prices for these rights are quite high. Groundwater rights in around Spanish Springs and Lemmon Valley near the Reno-Sparks area have sold in recent years for between $4,000 and $10,000 per acre-foot (Holt).

While many groundwater rights have sold for substantial sums of money, others have been traded away for almost nothing. Concerned with the dangerously poor condition of a some private water companies, in late 1983 Washoe County began acquiring the assets of these water companies and assuming the responsibility for water service. The county requires that the owners turn over all assets and rights of way necessary for providing water service to all existing customers, including all appropriated water rights. The county has generally refused to pay the owners more than the cost of their original capital investment. Prices paid for the water

rights portion of the assets usually do not exceed the cost of the original filing fee with the state engineer, about $100.

In one acquisition that took place in January, 1984, Washoe County bought a water company that had a small number of developed water rights and another 2,600 acre-feet of permitted, but undeveloped (and therefore uncertificated) water rights. The undeveloped water rights were in excess of those required for the operation of the water company for the existing users, so the owners were in a position to negotiate their sale separately. At first the water company owners asked a price of $1,500 per acre-foot, an amount equal to the going market price for Truckee River water rights. The county balked, pointing out that the groundwater permits were not transferable outside of the immediate area, so the rights had less value than water rights had in the Reno-Sparks area. Furthermore, the rights were uncertain since they had not yet been legally certified. The state engineer might deny the rights or not allow their full development. Washoe County finally purchased the 2,600 acre-feet of water rights permits at $50 per acre-foot. They will be used to support an expanded service area from the original water company (Collins).

Water rights in the TCID are difficult to transfer for two major reasons. First, as a federally funded and administered project, the status of the ownership of the water rights decreed for use on project lands by the individual water users has until recently never been clear. Furthermore, financial obligations to the project are based on land ownership and not water usage. There is no established mechanism in the Newlands Project for transferring project assessments with water rights that would move off project lands. Water used by the TCID is a mixture of water from two different river systems which are each administered under

their own federal decree. The ratio of the volumes of water diverted from each source have varied from year to year with the relative levels of flow in each stream. It is thought that any attempt to transfer of water rights from out of the TCID would create serious legal and administrative problems for the management of the Newlands Project (Stone).

Until recently no transfers of TCID water rights were permitted into, out of, or within the district. Since 1982, a decision by the US Supreme Court has established the legality of intra-district water rights transfers. In this ruling the court stated that TCID water rights are under the jurisdiction of the state engineer and constitute a right of property under Nevada state law. By mid-1985 about one-hundred proposed water rights transfers within the district have won provisional approval from the state engineer. The federal watermaster has not been involved in the transfers, because they have no effect on the rights belonging to TCID from either the Truckee or Carson rivers (McConnell).

Final approval of proposed water rights transfers within TCID are being withheld pending an appeal by the Pyramid Lake Indians. The dispute centers about the fact that the water rights being transferred are mostly appurtenant to marginal agricultural lands that have not used water for a long time. The Indians correctly interpret the transfers as an attempt by farmers in the TCID to use their allocation of water more fully and efficiently, thereby leaving less water available to flow into Pyramid Lake. The Indians are arguing that since the water rights have not been used, they have been abandoned and are available for appropriation. TCID counters that since the water rights were in use before the enactment of state statutes governing forfeiture and abandonment of water rights, they are not subject to those laws. Whatever is ultimately decided in this case

will have a strong bearing on whether or not water transfers will become commonplace in the TCID.

No price data were collected on transfers of TCID water rights, which are exclusively surface water rights. Groundwater rights in the Fallon area of the district are reported to be selling for about $300 per acre-foot.

Sierra Pacific began purchasing irrigation rights to supplement its original appropriation in the mid-1940's. An active program of purchasing water rights from old irrigation ditches started in 1946 and continued steadily until 1979. Prices (in 1984 dollars) ranged from a low of about $50 per acre-foot in 1946 to a peak of about $160 per acre-foot in the mid-1960's. From 1966 to 1979, the nominal price paid for water rights remained constant and the real price per acre-foot fell steadily. Most of the water rights acquisitions during the period from 1946 to 1979 occurred between the late 1950's and about 1970.

All of the water rights acquired by purchase retained the priority dates that were assigned to them under the Orr Ditch Decree. It was later determined that the firm yield (the minimum yield from the water rights that could be expected under the worst drought conditions) averaged about 58 percent of their long-term average yield. However Sierra Pacific's original senior appropriation has a firm yield of 100 percent of its long-term average yield (Moser).

By 1984, the water rights inventory of Sierra Pacific and the additional water rights available for purchase in the Truckee Meadows and elsewhere stood as follows: Sierra Pacific had water rights with an average yield of roughly 79,000 acre-feet per year. This included 29,000 acre-feet of originally adjudicated flow rights in the Truckee River, 12,000 acre-feet of groundwater, and 38,000 acre-feet of additional surface

water rights acquired since 1944. Approximately 38,000 acre-feet of water rights are still used for irrigation, 28,000 acre-feet in the Truckee Meadows area and 10,000 acre-feet in Sierra Valley, California. Finally, an estimated 32,000 acre-feet of water rights formerly used for irrigation are currently unused. These water rights are still appurtenant to lands that were incorporated into the service area of Sierra Pacific and provided with water service, without ever having the water rights severed from the land (Moser).

The present water market developed in the Truckee Meadows during the mid to late 1970's, when the Department of Interior refused to provide the water and storage rights in Stampede Reservoir for M&I purposes. The company had been counting on receiving between 17,000 and 34,000 acre-feet of additional water rights and regulatory storage space for as little as $17 per acre-foot through the project. Acquisitions of new water rights from irrigators declined to new lows as the real price offered by Sierra Pacific dipped below $75 per acre-foot.

Meanwhile, the cities of Reno and Sparks were experiencing unprecedented rates of growth. Water demand in the metropolitan areas was rapidly outgrowing Sierra Pacific's capacity to supply water service. In 1978 Sierra Pacific comissioned an independent study of its water resources and projected demands. The results, reported in 1979, stated that at the current rates of growth in water use in Sierra Pacific's service area, the firm yield on the company's existing inventory of water rights would be insufficient to meet demand within two or three years.

A water crisis hit the Truckee Meadows almost overnight. Suddenly the holders of water rights on the Truckee River awoke to the fact that they possessed a scarce and potentially highly valuable commodity. Land which

had until then been subdivided and bought and sold indiscriminately with its water rights intact began to have its water rights severed and hoarded by prudent investors. Sierra Pacific, reluctant to bear increased costs of acquiring water, at first refused to pay higher prices for water rights. In 1980 the utility reluctantly raised its offer price on water rights to between $70 and $100 per acre-foot, based on relative priority dates. Later the price ceiling was raised to $140 per acre-foot, and finally to $200 per acre-foot. The increase in the price offered was not enough to attract sufficient numbers of sellers. Water rights acquisitions by Sierra Pacific slowed to a trickle as owners held out for higher prices.

Faced with a growing water shortage, Sierra Pacific began rationing additional water service. A formula prepared by the office of the state engineer specified the precise quantity of water rights that would be necessary to provide a firm water supply for each new customer. Developers requesting water service were put on a lengthy waiting list pending the acquisition of sufficient water rights. The creation of the waiting list touched off an intense political battle between government and industry and between pro-growth and no-growth advocates. Private developers and the cities of Reno and Sparks accused the utility company of becoming a self-appointed regional planning agency. Environmental groups chastised the cities for living beyond their means.

Concerned that Sierra Pacific's water rights acquisition policy was obstructing a solution to the water crisis, the state Public Service Commission promulgated Rule 17 in early 1982. The rule gave organizations desiring new or expanded water service two options. Either they could obtain sufficient water rights themselves, lease them to Sierra Pacific directly and obtain water service immediately, or else they could place

themselves on Sierra Pacific's waiting list and wait for additional water rights to become available (Public Service Commission).

The cities of Reno and Sparks were wary of letting the Public Service Commission remove Sierra Pacific from the center of the planning process only to insert Commission officials in their place. As early as 1980 the cities began experimenting with various ordinances which would give developers the additional option of dedicating water rights to them in exchange for water service. The cities proposed keeping the title to the water rights in their own names, but providing the water rights to Sierra Pacific through long-term lease agreements.

State legislation was passed in the spring of 1983 regarding the disposition of the estimated 32,000 acre-feet of unused irrigation rights appurtenant to lands served by Sierra Pacific. The act, SB 323, authorized the cities of Reno and Sparks and Washoe County to acquire by purchase or condemnation the water rights appurtenant to these lands. Sierra Pacific was directed to "provide appropriate technical assistance," which meant all necessary title work on the rights.

In accepting water rights in exchange for water service, Sierra Pacific established the following guidelines. The water rights have to produce a firm yield of water sufficient to meet the estimated water demand for the proposed development. Firm yield is defined as 58 percent of the long-term average yield of the water right. The water rights have to be valid, decreed Truckee River water rights. If the new development is already within the service area of Sierra Pacific, the water right may come from either within or from outside the service area boundaries. If the new development is located on land that the applicant was seeking to have annexed into Sierra Pacific's service area, then the water right has to come from outside the current service area boundaries. Under certain

circumstances Sierra Pacific will consider accepting groundwater rights, if they have valid permits and it can be demonstrated that the water is reliable and of acceptable quality (Firth, 1979).

Between 1982 and 1984 the backlog of approved developments on Sierra Pacific's waiting list was not substantially reduced. While a so-called "black market" for water rights flourished among those developers willing to seek out and pay the market price for the rights, Sierra Pacific continued to abstain from agressively pursuing new acquisitions, offering low prices for water rights. Disturbed by what it viewed as an act of quiet defiance against Rule 17, the Public Service Commission strengthened the rule in a revised directive filed late in 1984. The new Rule 17 declared that Sierra Pacific had until April 1, 1985 to reduce the list of developments waiting for water service to zero. From that point on, any new development approved by the cities of Reno or Sparks or Washoe County had to be granted water service by the utility within 60 days of application.

Shortly after the announcement of the revised Rule 17, the cities of Reno and Sparks decided to take the initiative and the responsibility for water rights acquisitions upon themselves. Each city passed an ordinance in 1985 requiring developers to dedicate the necessary quantity of water rights to the city as a precondition for project approval. The cities would then in turn provide the water rights on the basis of 99-year leases to Sierra Pacific. The new Rule 17 was therefore made obsolete even before it could take effect, since new developments must already have made provisions for water rights before they formally apply to the company for water service. Sierra Pacific assists prospective buyers of water rights by providing a list of names of interested water rights sellers. The list

is periodically updated and is freely distributed by the company. Water rights acquired by the cities under SB 323 are "banked" by the appropriate local government authority until such time as the city or county wishes to use them in support of a particular development project.

Since the early 1980's, Rule 17, SB 323, and Sierra Pacific's guidelines for accepting water rights have established a new water market in the Truckee Meadows. Groundwater rights continue to be considered a low-valued and generally undesireable resource. Some groundwater rights owners have been unable to sell them for even as little as $50 per acre-foot. Priority dates for the various surface water water rights are usually irrelevant, since the river system has virtually never been administered on the basis of priority rights. For all practical purposes, any irrigation right in the system is considered to have the same firm yield of 58 percent of average yield. Prices for Truckee River flow rights within the service area of Sierra Pacific are high, ranging between about $1,000 and $1,500 per acre-foot. Truckee River flow rights outside of the service area of Sierra Pacific are the most valuable of all, with prices ranging from $1,500 to $2,000 per acre-foot. An independent water rights appraisal conducted in 1984 listed 52 water rights transactions between 1982 and 1984, with prices ranging from $875 to $2,016 per acre-foot (Test).

Larger lots of water rights tend to bring higher unit prices than do smaller lots of water rights, because of the high costs of transacting water rights transfers in the Truckee Meadows. Years of inadequate record-keeping by the office of the state engineer has created a great deal of confusion over the status of the water rights appurtenant to Truckee Meadows lands. Frequently it is not clear whether land that was subdivided from another parcel with an original water right decree retained any of the

water right or not. Water rights transfers are no longer permitted without first demonstrating that the seller of the right is really in possession of it. This often requires a lengthy and expensive title search. According to Sierra Pacific, the total cost for the title search, filing fees with the state engineer, and other costs for transferring a water right may run up to $1,000 per transaction or more. Larger blocks of water rights therefore tend to be more highly valued than smaller blocks of water rights, since more rights are transferable for the same transactions cost.

A survey conducted in March, 1985 by the Public Service Commission found that of the 32,000 acre-feet of water rights identified as subject to SB 323 acquisition, about 16,000 acre-feet were in blocks of less than 10 acre-feet and were the most likely candidates for purchase without having to resort to condemnation. The other 16,000 acre-feet were in blocks of 10 acre-feet or more, or which perhaps a dozen holdings were in excess of 100 acre-feet each. Of these 16,000 acre-feet of larger holdings, about 8,000 acre-feet were being retained by developers who wanted them for building projects. The remaining 8,000 acre-feet were held by owners who were willing to sell, the only question being the price. Of a dozen interested sellers who were contacted with offers of 1,000 to 1,100 per acre-foot, none accepted. Four counter-offers were given ranging from $1,750 to $2,000 per acre-foot (Holt).

Reno, Sparks, Washoe County, and Sierra Pacific have agreed to offer landowners $422 per acre-foot for their water rights under the SB 323 acquisition program. The price is based on a market value for the rights of $1,500 per acre-foot, less all transactions costs. Sierra Pacific leases the water rights from the cities and county for $422 per acre-foot, plus the costs to the local governments of handling the rights. When the water

rights are applied towards a new development, Sierra Pacific passes through to the new user its cost of acquiring the water right plus the expenses incurred in doing the title work on the transfer.

As of May, 1985, 6 months after beginning of the SB 323 program, Reno had succeeded in acquiring about 90 acre-feet of water rights and Sparks had picked up about 12 acre-feet. Most of the water rights purchased in lots of less than one acre-foot each, and nearly all of the transactions were for less than 2 acre-feet. Apparently most of those water rights owners who have agreed to sell have done so because they felt their quantity of water rights was too small to attract other buyers willing to bear all the transactions costs and pay them a higher unit price.

Sierra Pacific continues to consider the option of acquiring 9,400 acres of land with 10,000 acre-feet of Truckee River water rights in Sierra Valley, California. With land prices standing at at least $2,000 per acre, the cost per acre-foot of this acquisition would approach $2,000 per acre-foot. Local opposition to the proposed transfer is intense.

D. WATER MARKETS IN THE GILA SAN FRANCISCO BASIN, NEW MEXICO

1. General Description of the Study Area.

The market area chosen for study in New Mexico is the drainage basin of the Gila River, including its major tributary, the San Francisco River. The Gila-San Francisco basin is located in southwestern New Mexico, bordered on the east by the continental divide and on the west by the state of Arizona. Most of the land area in the basin is comprised of the Gila National Forest and the Gila Wilderness, vast expanses of sparsely populated forest and chaparrel environments at elevations of 6,000 to 10,000 feet. In the southern and western portions of the basin, where most of the population and most private landholdings are concentrated, elevations are lower and the forest gives way to grasslands and high desert.

Nearly all of the Gila San Francisco basin is contained within two counties, Catron County in the north and Grant County in the south. A very small portion of Hidalgo County is enclosed within the extreme southern end of the basin. The major urban center in the area is the town of Silver City, with a population of about 20,000. Silver City is located just outside the Gila-San Francisco basin, south and east of the continental divide in the Mimbris basin. Towns located within the Gila-Francisco basin are small and widely scattered. The principle settlements include Reserve and Glenwood in Catron County and Cliff and Redrock in Grant County.

The predominant industries in the Gila-San Francisco basin are mining and ranching. Irrigated crop farming has been on the decline for many years. Since the late 1960's a large number of vacation and retirement homes have been built in the vicinity of the national forest.

All of the criteria for selecting a water market study area are satisfied in the Gila-San Francisco basin. Water rights transfers have

been continuing at a steady pace for twenty years. Water is a scarce commodity and supplies will probably not increase by any significant quantity in the foreseeable future. A water development project, Conner Dam, is in the planning stages but progress is hampered by many environmental and economic problems and construction may not begin for a long time (Smith). Even if the project is built, it is expected that nearly all of the new water supplies would be delivered to Silver City, where most of the regional population growth is expected to occur, rather than to the Gila-San Francisco basin (Hernandez). Data on water market activity in both the Gila-San Francisco and Mimbris basins is available from the regional office of the state engineer in the town of Deming, Luna County, and from local water rights buyers, sellers, and brokers.

A total of about 30,000 acre-feet of groundwater and surface water rights are held in the Gila-San Francisco Basin. Nearly all of the water rights were originally used for irrigation. Roughly 6,500 acre-feet are held in the San Francisco portion of the basin, and 23,500 acre-feet are held in the Gila portion of the basin. The rights held in the San Francisco portion are used almost exclusively for irrigation and domestic purposes. The rights in the Gila portion are divided up in the following manner. Silver City holds some 700 acre-feet in water rights, of which it is permitted to export the consumptive use portion to the Mimbris basin. Mining companies hold about 11,800 acre-feet of rights, of which they also are entitled to use only the consumptive use portion. Domestic and irrigation users hold the remaining 10,000 acre-feet of rights.

Most of the water rights in the Gila-San Francisco basin are still surface water rights, but groundwater pumping is extensive. Surface water rights on the Gila and San Francisco rivers and on tributary streams are

usually supplied by ditch companies and are used mostly for irrigation. A large block of both surface and groundwater rights are used by the Phelps Dodge copper mine. The Boliden copper mine is still under construction, but will use groundwater exclusively once it is in operation. Silver City and a few other small towns and residential subdivisions operate collective water treatment and distribution systems which depend entirely upon groundwater. Most other domestic and commercial water users operate their own private groundwater wells.

Water market activity in the Gila-San Francisco basin has been observed since the basin was closed to additional appropriation in the mid-1960's. Thousands of acre-feet of water rights moved from irrigation to mining within the first few years. Most of these were nonmarket transfers of water rights from a large ranch to a newly-opened copper mine, both of which were owned by the Phelps Dodge Corporation. The ranch and its water rights had been acquired and developed by Phelps Dodge prior to the closing of the basin.

The Phelps Dodge development holds over 11,000 acre-feet of water rights, about half of all the water rights in the Gila portion of the Gila-San Francisco basin. The market for the remaining water rights has nevertheless been very active. Buyers include irrigation users, individual households, the town of Silver City, and a few smaller mines and commercial enterprises. The major commercial-industrial buyer of water rights in the Gila-San Francisco water market has been the Boliden Minerals Company, which acquired over 1,000 acre-feet of water rights for a new copper mine that it is opening 20 miles north of Silver City.

2. Research Activities in the Study Area.

Several different visits were paid to the study area during the

spring, summer and fall of 1985. Research time was divided between examining water rights files in the state engineer's office in Deming and conducting interviews with various market actors. Numerous individuals in the state engineer's office provided extremely valuable assistance. Other individuals who were interviewed included the Silver City state engineer, the Silver City attorney, local real estate brokers, a private engineering consultant, representatives from the local mining companies, and employees in the Grant County government.

Files maintained by the office of the state engineer provided a wealth of information on virtually every aspect of water rights transfers in the Gila-San Francisco basin, except the prices paid. Price data for many of the transactions were collected through personal contacts through the mail or by telephone. Additional price data were collected from the files of local realtors in Silver City and Glenwood.

3. Water Rights Laws and Institutions

Virtually all groundwater and surface water rights in New Mexico are subject to the legal doctrine of prior appropriation. A comprehensive administrative water code, passed by the territorial legistlature in 1907 and adopted by the newly constituted state government in 1912, remains the basic surface water law of New Mexico today. Groundwater was first regulated in 1931 (Clark).

New Mexico law charges the state engineer with the duty of administering all matters relating to the apportionment, transfer, and distribution of water. The state engineer must approve all new appropriations of water for beneficial use as well as changes in the place or purpose of existing uses. Jurisdiction of this office over the regulation of water rights includes all surface water rights and any

groundwater in declared groundwater basins. The state engineer designates a particular hydrologic region to be a declared groundwater basin when there is reason to believe that rapid development in the area might impair existing water rights. Most areas in the state are now included in one of over thirty declared groundwater basins.

No permit or license is required to appropriate waters in nondeclared basins. Appropriators are encouraged to register their water use with the state engineer in order to establish their claim. Declaring a basin has no effect on groundwater rights initiated before the declaration date. After that date, however, those wanting a water right or wanting to drill additional wells for an existing right must apply to the state engineer for a permit. If the water in a basin has been fully appropriated, which means that all available water resources have been allocated to existing users, the basin will be closed and no new water rights will be issued (Harris).

Anyone in New Mexico who cannot be served by a municipal or domestic water service organization may drill their own well for household use. Usually wells that provide water for a single household and irrigate no more than one acre of land are exempt from state regulation. In declared groundwater basins, however, even exempt wells must be registered with the state engineer. Exempt groundwater rights are routinely granted by the state engineer in most parts of New Mexico for indoor household use and for outdoor household purposes such as watering gardens, small orchards, lawns, washing cars, and filling swimming pools.

In New Mexico, a water right is a property right and inherent in that ownership is the perogative to change the point of diversion, place or use of the right. These changes, however, are governed by the overriding question of whether or not the change will impair existing water rights

holders. The right retains its priority date and its specific quantity of water after a transfer, so long as the right continues to be exercised.

Although the right to water is transferred automatically with the sale of the land unless reserved in the deed, a water right can be bought separately from the land or sold for a new use in another area. An owner can sell water rights from his land for use in another area if the transaction will not impair other rights in the new area. By doing so, the original owner withdraws the use of that water in the first area. The water withdrawn from use is adjusted for losses associated with the change of the point of diversion (including changes in consumptive use) and credited to the water supply in the second area. The new owner then is allowed to draw from this credited supply.

A person desiring to transfer a water right must make formal application and provide maps and a detailed description of the proposed change to a state engineer. If the application is in proper form, the state engineer will issue a "Notice for Publication" which must appear for three consecutive weeks in a newspaper of general circulation in the area in which the transfer is to take place. Any other person or entity holding a water right in the state of New Mexico may protest the transfer on the grounds that it would be detrimental to existing rights. At the request of the applicant, the state engineer will set a date and place for a hearing at which both sides of the question will be fully presented. Upon reaching a final decision on a protested application, the state engineer issues a "Findings and Order." Either party may appeal the decision of the state engineer by filing in a district court of the proper jurisdiction (Johnson).

Water right owners can sell their water right, in whole or in part, to another who may elect to change the point of diversion, storage or use without losing the right's priority date. The State Engineer must publish the proposed changes and, before allowing such a transfer, determine that no foreseeable detriment exists to other present right holders. The matter of detrimental effects is the only real basis the State Engineer has for denying the transfer of a valid water right.

Both groundwater and surface water rights can be sold or transferred. The transfer can be of both location and purpose. In some instances, where surface water and groundwater resources are considered to be integraly related, the State Engineer may allow transfers from surface appropriations to groundwater appropriations on a limited basis. Under these circumstances a new appropriation of groundwater may be permitted under the condition that the appropriator cease to use surface water rights in quantities sufficient to compensate for the effects of the groundwater pumping (Harris).

A water right owner can lease all or part of his right for not more than 10 years without affecting his original water right. A major benefit of leasing the right is that the owner avoids losing the right due to nonuse. New Mexico law states that a water right unused for four years is subject to forfeiture. The lease may be effective immediately, or the lease may be for future uses, as long as the proposed use does not impair other water users (Harris).

The Gila-San Francisco basin was declared in the mid 1960's following the US Supreme Court's adjudication of the lower Colorado River basin in the lawsuit Arizona vs. California. The basin has been closed to additional groundwater appropriations since 1967. As a federally adjudicated basin, the Gila-San Francisco faces particularly stringent

controls on the allocation, use and transfer of its water rights. A peculiar feature of the system of water rights in this basin is that appropriation of water rights for outside domestic use, something routinely granted even in closed groundwater basins elsewhere in the state, is not permitted. Households with exempt groundwater wells cannot maintain lawns, gardens, orchards or otherwise use any water outdoors unless additional water rights are acquired to serve that purpose. The Gila-San Francisco basin is unique in New Mexico and perhaps in the entire country in having an active market for individual household outdoor water rights (Dickson).

Water rights in the Gila San Francisco are appurtenant either to specific parcels of land for industrial, irrigation or household use, or to a municipal or rural-domestic water company service area. There are no mutual stock water companies. Following the issuance of the US Supreme Court's Rifkin Decree in March, 1964, the state of New Mexico adjudicated all water rights in the basin by specific point of diversion, place and purpose of use. Limited filings for additional appropriations were allowed to continue for about another two or three years (Alison).

Under the Rifkin decree, the Gila-San Francisco basin was divided into two separate and distinct sub-basins, the respective drainages of the Gila and the San Francisco Rivers. The court specified the maximum quantity of water that could be consumptively used from each of the two rivers before they converged and flowed into Arizona. Each sub-basin was in turn divided up into discrete Areas, and the maximum number of allowable irrigable acres within each Area was specified. There are four Areas in the San Francisco sub-basin, the Luna, Apache Creek, Reserve, and Glenwood Areas. There are three Areas in the Gila sub-basin, the Upper Gila, Cliff-Gila, and Redrock Areas. Part of another small Area located in the extreme southwest corner

of the Gila-San Francisco basin, the Virden Area, is treated separately and no transfers of water rights are permitted between it and the rest of the basin (U.S. Supreme Court).

During the state adjudication proceedings in the mid 1960's, the state engineer identified the exact acres of irrigated land, domestic households, and commercial enterprises that were putting water to beneficial use and had a valid claim to a water right. Commercial and industrial water rights were determined on the basis of their historic levels of use. Irrigation water rights were determined on the basis of three different measures. These were the maximum allowable diversion right per acre in any one year, a ten-year rolling average allowable diversion right, and the consumptive use portion of the right. All three measures are used to define water rights. These measures vary throughout the Gila-San Francisco basin, but are uniform within each one of the seven areas. For example, in the Cliff-Gila Area the consumptive use allowance is 1.61 acre-feet per acre per year. The maximum annual diversion is 3.4 acre-feet per acre per year. The ten year rolling average annual diversion is 2.9 acre-feet. Domestic well rights are fixed at three acre-feet per year throughout the Gila-San Francisco basin. There is no recognized consumptive use portion in a domestic well right (Alison).

Water rights transfers are permitted within the Gila-San Francisco basin, but are subject to the following restrictions. Water rights are not transferable between the two sub-basins (the Gila and the San Francisco though the consumptive use portion of any water right may be transported from one sub-basin to the other. Any diversion water right in any quantity may be transferred within any Area. Only the consumptive use portion of a water right may be transferred between Areas within a sub-basin. Surface water and groundwater throughout the Gila-San Francisco basin are

considered to be hydrologically identical and the rights to one may be converted into the other without altering the quantity or priority of the right. In some cases, however, where a surface water right is of very junior priority or is drawn from a an intermittant stream where the full extent of the right is not generally accessable, the diversion right may be adjusted downwards when converted into a groundwater appropriation.

Irrigation rights may be transferred to other purposes but water rights assigned to nonirrigation purposes may not be transferred for irrigation use. Within the last several years, a further restriction was placed on irrigation water rights, to the extent that no more than a single acre's worth of irrigation rights may be transferred at any one time between different Areas. Domestic well rights may be transferred anywhere within their respective sub-basins without changing the quantity of the right. Industrial water users who acquire irrigation rights are generally limited to divert no more than the consumptive use portion of the right, unless they can demonstrate to the state engineer's satisfaction that in their use of the water they generate a measureable return flow. The diversion right may then be adjusted upwards accordingly.

Water rights may not be "stacked" on the land. A homeowner with an acre of land could not acquire both a three acre-foot domestic well right and also additional irrigation rights. Neither may water rights be spread out. An owner of a 100-acre farm may acquire enough rights to irrigate all 100 acres or acquire any lesser quantity and irrigate less than 100 acres, but they could not irrigate all 100 acres without the appropriate quantity of water rights.

As elsewhere in New Mexico, water rights are not transferable into or out of the Gila-San Francisco basin, although the consumptive use portion

of any water right may be exported. The priority date of any water right remains with the right under any transfer of ownership, point of diversion, place or purpose of use. All transfers are, of course, subject to the state engineer's finding of nonimpairment to existing water rights. With the exception of exempt and domestic well rights, all rights must be "proved up" after their transfer. This means that the new user must demonstrate to the state engineer within a reasonable period of time that the water right is being put to beneficial use (Alison).

A few examples will illustrate how water rights transfers work in practice. Suppose a farmer irrigates 10 acres of land in the Cliff-Gila Area of the Gila sub-basin. His source of water is a local ditch company. His water rights in this Area allow him to use a maximum of 3.4 acre-feet per acre in any one year, so long as he does not use an average of more than 2.9 acre-feet per acre per year over any ten-year period. The consumptive use portion of his right is 1.61 acre-feet per acre per year. If the farmer wishes to transfer his water right to another farmer in the Cliff-Gila Area, he may transfer the entire right. He may not transfer the entire 10 acre's of rights to farmers in other Areas, but he could transfer up to one acre's worth of rights to any individual outside the Cliff-Gila Area. Suppose he sells one acre of water rights to a farmer in the Redrock Area, another acre of rights to a homeowner in the Redrock Area, four acres of rights to Silver City (for use in their Cliff-Gila Area well field), and the last four acres of rights to a copper mine in his own Area. The farmer must retire his 10 acres of land from irrigation.

Both the Redrock Area farmer and the homeowner in Redrock get a consumptive use right for 1.61 acre-feet of water. The consumptive use allowance in the Redrock Area)such allowances vary among Areas) is 1.70 acre-feet per acre, and the long-term average diversion right is 2.9 acre-

feet per acre. Each of the new owners would be able to irrigate (or, in the case of the homeowner, water his garden, wash his car, and fill his swimming pool) a total of 1.61 / 1.70 = 0.95 acres. While the farmer in Cliff-Gila sold two acres of water rights with a long-term average yield of 2.9 acre-feet per acre on each, the new owners have each acquired only 0.95 x 2.9 = 2.75 acre-feet of water rights.

The copper mine in the Cliff-Gila Area picked up 4 acres of water rights with a consumptive use allowance of 1.61 acre-feet per acre. If they can meter their water use and demonstrate that they generate some return flow, the state engineer may increase their diversion right. Otherwise, they may not use more than 4 x 1.61 = 6.44 acre-feet of water per year. Silver City is located outside the Gila-San Francisco basin. They may not transfer the water right out of the basin, but they may be able to transfer the right to their wellfield in the Cliff-Gila Area. From the wellfield they may pump and export the consumptive use portion of their 4 acres of water rights, or (6.44 acre-feet per year) out of the basin to Silver City, consistent with New Mexico's policy that "paper water" (water rights) may not leave a basin, but that "wet water" may be transported out of a basin.

Suppose the original owner, the farmer in Cliff-Gila, decides to get back into irrigated farming. He may purchase or rent enough water rights to irrigate all or any portion of his 10 acres. Alternatively, suppose he chooses to subdivide all or part of the farm into residential housing units. Some of the new homeowners might be content to drill an exempt well and use the water for inhouse use only. Others might wish to plant a garden on their property and would need to acquire some water rights for that purpose. An owner of a three-acre lot, for example, might choose to

acquire sufficient water rights to irrigate a 1/2 acre garden, which in this case would be 1.45 acre-feet.

4. Water Market Activity.

Five different aspects of the southwestern New Mexico water market are discussed. These are the San Francisco sub-basin water rights market, the Gila sub-basin water market, the water rental market in the Gila and the San Francisco sub-basins, and water rights acquisitions by Silver City.

Almost all water rights in the San Francisco sub-basin are used for irrigation or municipal and domestic purposes. A few small mills and a small mine are the only commercial water users in the area. Market transfers of water rights did not begin in the San Francisco sub-basin on a significant scale until the mid to late 1970's, about ten years after they began in the Gila sub-basin. Most transfers have been in small quantities of three to six acre-feet or less. Prices adjusted to constant 1984 dollars were about $500 in the late 1970's. Afterwards they rose quickly to as much as $3,000 per acre-foot. Most real prices since 1980 have ranged from about $1,500 to $2,000 per acre-foot. There has been no observable trend in prices since the early increases between the late 1970's and 1980.

A substantial portion of the water rights in the Gila sub-basin are controlled by three major entities, the Phelps Dodge and Boliden mines and the town of Silver City. The remaining water rights have been actively traded in relatively small quantities. Many transactions involve parcels of water rights as small as those traded in the San Francisco sub-basin, but sales of water rights in excess of 50 acre-feet have not been uncommon. The earliest sale of water rights dates back to 1966, and the price adjusted to 1984 constant dollars was about $1,300 per acre-foot. Real

prices for water rights increased slightly through the 1970's to a range of about $1,700 to $3,000 per acre-foot. Real prices have not changed significantly since the late 1970's.

Small quantities of water rights have tended to cost more per acre-foot than large quantities of water rights, since the small quantities are most often purchased by new homeowners with a high willingness to pay for water. However, the relationship between the cost of a water right and the quantity of water has not been absolute. Some large quantities of water rights have sold for very high prices while some small quantities have sold for lower than average prices.

Price increases in the Gila sub-basin during the late 1970's may be attributable to the entrance of the Exxon Corporation into the water market. In 1979 and 1980 Exxon negotiated with about 25 different parties for the sale of as much as 1,200 acre-feet of irrigation water rights for transfer to mining. Roughly half of the transactions involved the sale of only water rights, and the other half involved the sale of land and water rights together. In 1982 Exxon sold most of its assets, including its water rights, to Boliden.

Exxon contracted to buy the land and water rights through five-year annually renewable sales option agreements. Options prices for the properties varied between $2,500 and $5,000 per acre (about $850 to $1700 per acre-foot). The effective cost of the water for Boliden is much higher, since they may only use the consumptive use portion of each water right. Considering the volume of water they will actually have at their disposal, the cost to them for the water rights was actually between about $1,600 and $3,100 per acre-foot.

Annual options payments ranged from 6 percent to 10 percent of the option price. These were always nonrefundable and were usually not

deductable from the sales price. In a few cases, a down payment of about 20 percent in the first option year substituted for annual payments. Some options were exercised as early as 1981, but most sales were not concluded until late in 1984. Only two or three options were cancelled.

Each option contract between Exxon and the sellers was negotiated separately, and the prices agreed upon seem to be a function of the negotiating skills on each side. There appears to be no clear relationship between the option price and the size of the sale, or between the option price and inclusion or exclusion of appurtenant land.

Discussions with market actors and a close examination of the state engineer's records indicates that a large number of the temporary transfers (leases) of water rights were nonmarket transactions. Price data on five transfers, one in the San Francisco sub-basin and four in the Gila sub-basin were collected, covering the years from 1963 to 1983. Prices adjusted to 1984 constant dollar values ranged between about $100 and $250 per acre-foot, with no evidence of any trend either up or down over time. The rental price for water in the Gila-San Francisco basin stands at roughly 10 percent of the sales price (Jackson).

Silver City owns water rights in both the Mimbris and Gila-San Francisco basin. Part of the rights were appropriated and developed at a very low cost, and part were purchased at high market prices. Until 1982, nearly all of the water rights owned by Silver City were concentrated in two groundwater wellfields, the Franks field in the Gila-San Francisco basin and the Woodward Field in the Mimbris basin. The smaller Anderson wellfield is operated conjunctively with the Woodward facilities. Since 1982 groundwater rights in two new areas in the Mimbris basin have been acquired by the city (Shoemaker).

Rights to develop groundwater on the Franks ranch were acquired by contract in 1945, more than twenty years before the basin was closed to additional appropriation. Silver city agreed to pay the landowners a rent of about $3.5 per acre-foot of water pumped and transported off the ranch. The contract had no termination date and there was no inflation adjustment clause. The price paid for the water has not increased since 1945. A similar contract allowed Silver City to develop the Woodward field in 1954. The Woodward contract was amended in 1967 to increase the rental price to slightly less than $5 per acre-foot. Silver City has the right to pump about 1,500 acre-feet per year from the Woodward Wellfield, about 800 acre-feet per year from the Franks Wellfield, and an additional 400 acre-feet per year from the Anderson wells.

Some additional groundwater rights were purchased by the city in the Gila sub-basin. In 1981 the city purchased 78 acre-feet of water rights with a consumptive use of 43 acre-feet for cost of about $2,800 (1984 dollars) per acre-foot of transportable water. In 1984 the city purchased another 136 acre-feet of transportable water at a cost of $2,750 per acre-foot. In 1985 the city acquired 32 acre-feet of transportable water for slightly less than $2,000 per acre-foot. All of these water rights were successfully transferred to the Franks Wellfield, and the transportable (consumptive use) portion of each right is being pumped over the continental divide into the Mimbris basin.

Two purchases were made in the Mimbris basin. In 1982 Silver paid about $1,500 (1984 dollars) per acre-foot for 193 acre-feet of water rights. In 1985, 1,433 acre-feet of water rights were acquired for $3.1 million, or about $2,150 per acre-foot.

E. WATER MARKETS IN THE LOWER SEVIER RIVER BASIN, UTAH

1. General Description of the Study Area

The market area chosen for study in Utah is the lower Sevier River basin of west-central Utah. The Sevier River begins in the highland plateaus of Southwestern Utah, flowing north for about 150 miles before turning south and west for a short distance to terminate in Sevier Lake. The area lies within the sparsely populated, isolated, and extremely arid Sevier Desert. Average annual precipitation totals less than 8 inches. The principal population center is the town of Delta, with approximately 5,000 residents. It lies in the northeastern corner of Millard County, about 140 south and west of Salt Lake City. Other small towns near Delta are Hinckley, Sutherland, Deseret, and Oasis. Also included within the study area are the towns of Lynndyl and Leamington, located along the Sevier River 15 and 20 miles north of Delta, respectively.

Approximately 50,000 acres are irrigated in the vicinity of the northern bend of the lower Sevier River. Agriculture is the mainstay of the local economy and the primary water user in the area. Alfalfa and alfalfa seed are the major products. A significant quantity of acreage is also devoted to small grain crops, especially barley. A recent addition to the economy and soon to be a major new water user in the area is a huge coal-fired electric power generating facility, north of Delta and southwest of Lynndyl, the Intermountain Power Project (IPP). Currently under construction, IPP will have several hundred permanent employees when it begins full-scale operations between 1986 and 1987. Except for the introduction of IPP, population growth and economic expansion in the Delta area has been slow.

Four mutual ditch companies cooperatively manage most of the surface water supplies within the study area. The four companies, named Delta,

Mellville, Abraham, and Deseret, are collectively known as the DMAD companies. A fifth company, the Central Utah Irrigation Company, distributes water out of the Sevier River just upstream from the DMAD system. Three reservoirs are operated on the lower Sevier River, Gunnison, DMAD, Bend, and Sevier Bridge. Gunnison Bend, the smallest with a storage capacity of 4,500 acre-feet, is owned exclusively by the Abraham and Deseret Companies. DMAD Reservoir, with a capacity of 11,500 acre-feet, is owned by all four of the DMAD companies. Sevier Bridge, by far the largest reservoir with a storage capacity of 235,000 acre-feet, is owned jointly by the DMAD companies and the Central Utah Irrigation Company (Tenney).

An average total of about 120,000 acre-feet of water per year are delivered through the DMAD system within the service areas of the companies. The water supply is predominantly direct flow and storage water from the Sevier River. Several shallow groundwater wells are owned and operated by the DMAD companies for the purpose of supplementing the flow of the Sevier River in a dry year. Groundwater is also pumped into the river to control salinity levels. As much as 28,000 acre-feet of groundwater per year may be diverted into the river, although the volume pumped is usually much less. Groundwater rights have been developed by private individuals for household use and for supplementing their surface water supplies during critical periods.

The high level of salinity in the Sevier River prevents the water from being used for human consumption. Groundwater quality, however, is generally good throughout the basin. It is the only source of water for domestic, municipal, and also for most commercial water users, the IPP being the only major exception.

Most of the criteria for selecting water market study areas were met in the lower Sevier River basin, especially with respect to the water rental market. Good historical data on quantities and prices for rentals are available from the DMAD central office. Water stock transfers have also been recorded in detail in the DMAD office, but most of the transfers included land and price data specific to water rights are few and difficult to collect. The groundwater market is interesting but small and relatively new. Price data on groundwater transfers are only available only for a few recent years, and the observations are dominated by a small number of large acquisitions by IPP.

Water supplies are scarce in the lower Sevier Basin, but with few exceptions the marginal willingness to pay for water rights is lower than in most other water markets studied. Negotiations are under way with the Central Utah Water Conservancy District to divert 12,000 acre feet per year of Central Utah Project water into the lower Sevier. It has not yet been determined when the water would be available, to whom, and for what purpose, and at what cost (Tenney).

2. Research Activities in the Study Area

Site visits were conducted during the spring, summer and fall of 1985. Most research time and effort was devoted to studying the DMAD water rental and water stock markets. Data were also collected on the IPP water rights acquisitions and on the groundwater rights market in the Delta and Lynndyl areas.

Comprehensive records covering over 50 years of water rentals and water stock sales are on file in the DMAD central office and were made available for the purposes of this research. Price data are generally not recorded in the DMAD office. Historical rental prices may be inferred,

however, from the records of receipts of the Melville Irrigation Company, which owns water stock in the Delta Canal Company and usually rents it out every year. Some information on groundwater rights sales are available from IPP's water purchase records. Most other price data on surface water and groundwater rights prices were collected from private sources in the Delta area.

A number of individuals in the Delta area and elsewhere in Utah provided valuable information on the water market in the lower Sevier basin. Persons interviewed included representatives from the town of Delta, IPP, the Bureau of Reclamation, DMAD, and the state Division of Water Resources, and individual farmers, bankers, real estate brokers, developers and attorneys.

Good but dated secondary sources on the DMAD surface water rental market are available from studies conducted by research personnel at Utah State University in the mid-1960's. The studies provide good descriptions of the water markets and analysis of price data.

3. Water Laws and Institutions

Under the direction of the Morman Church, water rights were developed according to the doctrine of prior appropriation. The earliest water legislation did not grant individuals the right to appropriate water in the sense in which that right is accorded now. It comprised grants of water privileges to individuals and communities, and it authorized public officials to make grants. As early as 1880, the territorial supreme court of Utah recognized the prior appropriation doctrine. In 1903, Utah enacted its first administrative law for water rights, which was exclusive in the field of appropriation and replaced all preexisting procedures (Hutchins, 1977).

The doctrine of absolute priorities was not followed in Utah to the extent that the Mormans gave greater weight to proportionate sharing of water shortages and to beneficial use of the resource. When rights to Utah streams were apportioned, each claimant canal was assigned shares or percentages of flow. The shares assigned to each canal were based on priority of appropriation - the canals that had first diverted water and put it to use in irrigation water were given preference over later canals, but this principle was far from absolute. Time priority was modified considerably by several factors, first among them being the actual use of water at the time an allocation was made. When a stream came to be apportioned among canals - and this happened only when apportionments began to exceed the stream's capacity - the actual uses of water by each canal were measured; and these measures became an important factor in the apportionment, more so than specific dates of first claims to water. To the extent that apportionment was based on actual use and to the extent that all canals were using water with equal efficiency at the time of apportionment, the agreements allotted water to each canal according to the amount of land that was dependent on the canal for water supply (Maas).

The second modification of the appropriation doctrine in Utah was the apportionment of the variable water supply by fractions instead of by physical volumes. In this way, the effects of drought were spread over all users instead of the most junior appropriators (Maas).

In order to prevent over-allocation of the water supplies, Utah instituted a third modification of the appropriation system by introducing primary and secondary rights. In general, primary water users are ensured adequate water supplies to meet all demands even during periods of drought, while holders of secondary rights may not always be able to take delivery of their prorated allocation. This division of water rights into classes

was peculiar to Utah in the western United States, and was Utah's method for achieving a higher degree of sharing of the costs of drought than was possible in systems that use an absolute priority system (Maas).

The Utah groundwater law has followed a chronological path, from the English rule to the correlative rights doctrine to the present prior appropriation doctrine. The present doctrinal basis permitted the elimination of the historical distinction between groundwater and surface water, with the result that waters of all sources are declared to be public property subject to appropriation. Since 1935, acquiring a right to water, regardless of the type of source, is initiated by the filing of an application to the State Engineer (Chalmers).

The office of the State Engineer was created in 1897. At first the his duties consisted chiefly of measuring streams, approving plans for dams, and supervising State irrigation works. In 1901 the State Engineer was given general supervision over the distribution of water, and in 1903 his duties were extended to include the receipt of and approval of applications to appropriate water, and investigation of matters on which stream adjudications should be initiated. The 1903 statute, which was a complete "water code," was revised and reenacted in 1905 and again in 1919. The 1919 law was carried over into succeeding complete reenactments of State statutes and, as amended, is presently in force (Hutchins, 1965).

The Utah State Engineer is the chief water rights administrative officer of the State. He has "general administrative supervision of the waters of the state, and of the measurement, appropriation, apportionment and distribution thereof." The statutory procedure for the determination of water rights is initiated with an action by the state engineer filed in the appropriate district court. The state engineer's report forms the

basis on which the court makes a final determination. He is also responsible for appointing water commissioners to distribute water from all or parts of any river system or water source. The state engineer is authorized to hold hearings to determine whether the underground water supply within a given area is adequate for the existing claims. Should an inadequacy be determined, division among claimants shall be made upon the basis of priority. Additional provisions in the law permit the state engineer to regulate and control wells such that waste is avoided and use does not exceed rights. He also has the power to obtain reports on water levels and the quantity of groundwater used.

Once a hydrologic basin is determined to be closed, additional development must be accomplished by purchase of an existing water right and the filing of a change or exchange application. The state engineer has the authority to prevent groundwater rights transfers if existing rights would be impaired or if the transfer would adversely affect the management and conservation of water resources in the area.

Groundwater rights and transfers are strictly controlled in the Delta-Lynndyl area. The groundwater basin is closed to additional appropriation. All lands surrounding the town of Delta and lying east and south of the Sevier River are considered to be within a "high impact" part of the basin. Not surprisingly, this is where most of the area's population, growth pressures, and economic activity are located. Groundwater transfers are permitted within and out of the high impact area, but none are permitted into the area from regions west and north of the Sevier River. The state engineer also distinguishes between shallow and deep groundwater wells and rights. The best water quality is generally found in wells drawing from the deeper groundwater aquifers. Transfers of rights are not permitted between wells that access water from different

hydrologic formations in the basin. High quality groundwater within the high-impact portion of the basin is scarce and highly-valued (Forbush).

Nearly all of the irrigation water used in Utah is distributed through organized irrigation entities. The Morman pioneers in the Great Basin were the first Anglo-Saxons to practice irrigation on an extensive scale in the United States. When Utah was first settled, dams and ditches were constructed on a community basis under the supervision of the Morman Church. From the first, management and utilization of the irrigation water supply was one of the major activities. Originally the irrigation systems were voluntary cooperative ventures run principally by the village officials, who were almost always functionaries in the local ward of the Morman church. In time, the church's control of these irrigation organizations was replaced by farmer control. There were few farmers in the Utah Valley who owned water rights. When the first settlers diverted streams for irrigation, the water they abstracted was considered the property of the community of farmers that built the ditches or of the larger municipality. Individual rights were not recognized as such, each settler's interest being considered part of the community right. The successors of these early cooperative organizations are Utah's most common form of private irrigation company and are called mutual water companies (Hutchins, 1977).

When these informal ditch communities became mutual companies, their water rights passed to the companies, as did those of any individual farmer who, claiming separate water rights, joined a company. The informal mutual companies then issued certification to farmers for the use of water on stated numbers of acres of land; the formal ones issued stocks or shares to farmers for the use of water on stated numbers of acres of land;

the formal ones issued stocks or shares to farmers in proportion to their traditional uses of water. Out of earlier forms of organization, the typical Utah mutual irrigation company evolved the dominant form of irrigation organization in the state, the larger ones being incorporated.

A mutual water company is a nonprofit corporation which owns diversion and/or storage facilities, delivers water at cost to the shareholders, and derives its operating capital from assessments levied against shareholders. In organization, management, and dissolution, mutual water companies resemble other private corporations. The main differences are the type of assets the company holds (such as water rights and canal systems), the assessable nature of the stock, and the nature of the return to the stockholders. Shareholder rights in a mutual water company are essentially the same as in an ordinary corporation, but shareholders in a mutual water company receive a proportionate share of the corporation's water supply rather than dividends or a distribution of corporate assets.

In Utah, unlike most other western states, water rights which are represented by stock in a nonprofit mutual irrigation company are not appurtenant to the land upon which the water is used. Individual stockholders are not subject to state laws regulating the beneficial use of water rights. They may own as many or as few shares of water stock as they wish, regardless of whether they own sufficient land on which to use the water or not. A farmer who has a right to more water than he plans to use in a given season or in a given rotation may rent his rights to a farmer who wants it. An individual may own water stock without owning any land at all, and rent out the entire portfollio of water rights every year. Conversely, a farmer may own land and own no water stock and rent the desired quantity every season. Arrangements for such transactions are usually quite informal. The only condition on the use of the water

transferred is that it be used within the decreed service area of the mutual stock company.

Water rights represented by mutual water stock can be transferred between farmers simply by transferring the stock. The transfer of stock representing water rights in a mutual water company does not require administrative proceedings before the state engineer to change the point of diversion or place of use of the water. Such proceedings are required in transfers of water rights not represented by mutual company stock. Water rights which are not represented by stock, however, are appurtentant to the land for which the appropriation was made, but they may be severed from the land and sold separately. Unless specifically reserved by the grantor, appurtenant water rights automatically pass with a sale of the land (Anderson).

The transfer of water stock outside of the service area of the mutual stock company requires the filing of an application before the state engineer requesting a change in the point of diversion. If a change in the place of diversion is not within the boundaries of the controlling irrigation company an administrative hearing is required, but the change will usually be allowed if it does not interfere with the rights of others.

Water rights in the lower Sevier River basin were adjudicated under the Cox Decree of 1936. The local mutual ditch companies had already been in existence for many years. As was typically the case in Utah, the water rights were assigned to each water company on the basis of current use and not prior appropriation. The timing and distribution of proportional shares of the streamflow were specified, along with formulae for equitably prorating water supplies to all users during drought years.

Water transfers among the water users within each of the different water companies had been a common practice almost since the very beginning. In the early 1950's, the DMAD governing boards instituted an agreement to permit the seasonal transfer of water between companies. Normally, the transfer of water among different mutual stock companies would require transfer proceedings before the state engineer. Since the DMAD were located near the end of the Sevier River and there were virtually no downstream users who could be impacted by any transfer or change in use of the water in the system, the state engineer raised no formal objection to the practice (Bassett).

Intercompany water transfers among the DMAD group continued without formal legal sanction for many years. In 1980, upon approving the change application to transfer DMAD and Central Utah company water to IPP, the state engineer finally declared that the points of diversion and place of use for the four DMAD companies were interchangeable. Multiple use purposes were granted for all the water rights transferred, allowing the seasonal rental of water unused by IPP back to irrigators. The DMAD company secretary works closely with the river commissioner for the lower Sevier River to ensure that all water accounts "balance," and that the total appropriations by each of the DMAD companies do not exceed the legal limit of their prorated shares for that year (Walker).

Each spring the governing boards of each of the four DMAD companies determine the water "credit" to be issued on each share of outstanding water stock. Stockholders are given water accounts which function much like a bank account. Water may be withdrawn from the account at any time during the irrigation season, or deposits may be registered by transferring water from another stockholder's account. DMAD permits anyone owning or renting company water to carry over any part or all of their holdings to

the following irrigation season, less 20 percent to account for evaporation losses. Water may not be carried over for more than a single year. This option permits a greater degree of flexibility for the individual farmer in managing his water resources, but there is some risk involved. If the storage capacity of the reservoirs is reached at the beginning of the following irrigation season, all carryover accounts are erased and water credits are reissued to all stockholders based on the total available water supply (Tenney).

Intracompany and intercompany water rentals within the DMAD system are handled in exactly the same manner. The owner of water stock wishing to rent water fills out a card to give to the DMAD company secretary. Providing that there is still sufficient water credit left in the individual's water account for that season, the requested quantity of water is debited against the renter's account and credited to the rentee's account. Usually the quantity of the rental is accounted for in acre-feet of deliverable water, but sometimes the parties may choose to rent shares of water stock instead. Most seasonal transfers of water stock are associated with the leasing of farmland on which the water stock had been used, and the renter transfers the entire package to the rentee. The individual renting the water has the option of using the water in the current irrigation season, or to take the risk of carrying the water over into the next season (Tenney).

4. Water Market Activity

Three different water markets are discussed, the market for DMAD water stock, the DMAD rental market for Sevier River water, and the market for groundwater rights in the Delta-Lynndyl area.

The management of the DMAD companies has been highly integrated since

at least the early 1960's. There is no longer any practical distinction between owning shares of stock in one company or another, except that the historic average yields per share of stock differ. The market price for the water represented by a share of stock is similar among the companies and currently stands at about $350 per acre foot (Tenney).

Water rights prices between 1974 and 1985 exhibit no trend either up or down except for one brief period between 1979 and 1982, when the introduction of the IPP to the Delta area invited a rush of speculation in land and water rights. IPP paid over $2,100 per acre-foot for one large package of water company stock. In other sales of water stock at the same time, real prices quickly jumped to over $1,000 per acre-foot. Within a year or two the speculative bubble collapsed. Water stock prices had largely returned to their former levels by about 1983.

When the group of utility companies and municipal power suppliers belonging to the Intermountain Power Association decided to build a new electric generating plant in the Delta area, they knew that the success of the project was contingent upon securing an adequate quantity of water rights. In 1979 they concluded an agreement with a consortium of groundwater and surface water rights holders in the Delta and Lynndyl areas known as the Joint Venture. Slightly over 45,000 acre-feet in water company stock and privately decreed groundwater rights were purchased for a nominal price of $1,750 per acre-foot. When payment was made in 1981, the price was adjusted upwards slightly to about $1,830 per acre-foot. In 1984 constant dollars, the price paid by IPP per acre-foot was equal to roughly $2,100 per acre-foot.

The 45,000 acre-feet of water rights was composed of a package of 5,400 acre-feet in groundwater rights and 39,600 acre-feet in water company

stock. The stock consisted of about 20 percent of all the water stock in each of the DMAD companies plus 85 percent of the Central Utah Irrigation Company. Many different sellers were involved in the transfer, and most of the water rights were sold in relatively small lots. There were 656 individual contracts signed for the purchase of water company stock, or an average of about 60 acre-feet per contract. Another 31 contracts were signed for the sale of groundwater rights, or an average of 174 acre-feet per contract (Novak).

The Joint Venture was formed after a core group of organizers advertised in the local newspapers in 1978. Anyone owning stock in the DMAD or Central Utah companies and anyone owning groundwater rights in the Delta or Lynndyl areas was invited to participate in the sale to IPP. Each participant was allowed to offer a prorated quantity of water rights for sale, determined on the basis of the water rights required for the transfer and the total number of water rights owned by the Joint Venture participants. Individuals were free to offer more than their basic allotment of their water rights for sale, but they had to find another participant who was willing to reduce their allotment by a compensating amount. An active market in sales options sprang up. Options prices for the sale of groundwater rights to IPP through the Joint Venture are reported to have sold initially for between $600 and $650 per acre-foot (nominal prices in the late 1970's) (Neilson).

The option market for groundwater rights changed suddenly with the issuance of an interlocutory order by the state engineer. Groundwater rights in Utah are not quantified volumetrically, but in terms of a flow rate. In order to determine how much groundwater could be transferred to IPP, the state engineer had to make a determination of the consumptive use for groundwater in the areas where the sales were meant to take place. To

the dismay of the Joint Venture participants, the state engineer issued an interlocutory order (it is not final pending further hydrologic studies) stating that the consumptive use portion of the groundwater rights in the affected areas was only about half of the average volume diverted. IPP had specified in the negotiations that it would only pay for the volume of water that was transferable, not the volume of the rights as they were. Option prices for groundwater rights are reported to have fallen at least in half, to about $300 nominal dollars per acre-foot. Nevertheless, sufficient water rights were still offered to complete the water rights package (Neilson).

No final order has yet been issued by the state engineer. If the interlocutory order stands, the farmers who sold groundwater rights to IPP will have to dry up twice as much acreage as they originally thought they would have had to retire from irrigation. The Joint Venture has threatened to sue the state engineer if the order is upheld.

Although there might be some question about the future of some of the lands in the Delta area that are dependent upon groundwater, in general it is not expected that there will be a significant loss in agricultural production as a result of the sale of water rights to IPP. Three reasons are given for this optimistic outlook. The first is that by virtue of the types of changes that will be made in the management of the DMAD system to accomodate the diversions of water by IPP, water quality in the system will actually improve. IPP will be able to use the most saline sources of water for its operations, leaving the less saline water sources behind for irrigation. Farmers should therefore to experience an increase in average crop yields. Another reason given is that many of the farmers in the Delta area are reinvesting their earnings from the sale of water stock in laser-

leveling their fields and upgrading their irrigation systems. Farmers will therefore be able to use less water to irrigate the same acreage. Finally, only the most marginal lands will removed from production. Since the water rights owned by the farmers are appurtenant not to any specific parcels of land but rather to the entire water company service area, they are free to choose which lands they wish to irrigate and which to retire (Waddingham).

Shortly after concluding the sale of the water rights, IPP announced that it would scale back the design of the facility from four power generating units to only two. IPP now expects to use only 20,000 acre-feet of water of its 45,000 acre-feet in rights. The excess water rights will be retained in anticipation of future plant expansion. Unused water supplies will be rented back each year to individual water users in the irrigation companies. Water has traditionally only been rented for one season at a time in the lower Sevier basin. Since IPP has such a large quantity of water rights that it will not be using any time in the foreseeable future, however, the plant is considering making arrangements to lease some of the water for five to ten years (Perez).

Since the sale of Joint Venture stock in 1981, IPP has become the dominant renter of water in the DMAD system. There is no a priori means of determining what the effect this will have on water rental prices. Prices might tend to be lower, since the IPP controls at least twice the firm water supply than it will use at its currently designed scale of operations and will therefore usually have large quantities of water available for rent. Prices may also turn out to be higher, if the level of irrigation water use remains high and pushes up the demand for rental water. In 1980, the year before IPP began renting water, flows in the Sevier River were high and the real price of rental water fell from $28 per acre-foot the previous year to only $6.25 per acre-foot. During the following two years

flows were closer to the average, but rental prices only rose slightly, to between $8 and $8.50 per acre-foot. The real impact of IPP on the water rental market may not be known for several years. Coinciding with the IPP sale the Sevier River system entered upon an unprecedented wet cycle that has persisted into 1985. The rental market has been inactive since 1982.

Water rental prices between 1948 and 1982 ranged between about $7 and $70 per acre-foot, adjusted to constant 1984 dollars. Real prices generally increased from a range of $7 to $20 per acre-foot in the late 1940's and early 1950's to a range of $20 to $70 per acre-foot in the mid-1950's through the mid-1960's. Since the late 1960's the rental price has declined again to a range of $8 to $25 per acre-foot. From year to year the price fluctuated greatly. Between 1953 and 1954, for example, rental prices increased from $9.71 per acre-foot to $23.27 per acre-foot. Between 1967 and 1968, real prices fell from $50 per acre-foot to $23.53 per acre-foot.

A study of water rental price behavior between 1946 and 1963 in the Delta area conducted at Utah State University indicated that fluctuations in water rental prices are strongly related to the hydrologic cycles of the Sevier river. Rental prices tend to be high in dry years when water supplies are low, and low in wet years when water supplies are high. Rental activity is busiest during the spring and summer months, and from year to year the volume of rentals varies with the total supply of water. The volume of rentals is lowest in very wet years because supplies are more than adequate for most stockholders and demand for additional water is low. The volume of water rented is also low in very dry years when supplies are tight and prices for water are high enough to cut off a lot of demand that would otherwise be in the market. Rental activity appears to be the

highest in moderately dry years, when demand for water is strong and there is some flexibility in the supply (Stewart).

No data were obtainable on groundwater rights prices prior to the IPP's purchase from the Joint Venture. IPP bought groundwater rights for two different purposes. One was to supply supplemental water for their power generating operations. The 5,400 acre-feet of groundwater rights acquired for this purpose were purchased from the Joint venture for the same unit acre-foot price as was paid for the water company stock. A second bundle of groundwater rights were purchased from a number of private individual to create a "water bank" for the town of Delta to support urban growth. IPP paid an average price in constant 1984 dollars of $1,200 per acre-foot. New developments in the Delta service area must now pay a raw water fee in order to get hooked up to the town water system. The charge, $1,000 per acre-foot, is based on the average nominal price paid by IPP for the water rights, $960 per acre foot, plus a $40 handling charge. As new users pay Delta for the water rights, Delta reimburses IPP for the cost of acquiring them (Intermountain Power Agency, Forster).

Real prices for groundwater rights have fallen since 1980 in much the same manner as prices for water company stock fell during the same period. Real prices (excluding the Joint Venture sale) observed in 1980 and 1981 ranged between $900 and $1,200 per acre-foot. Since 1982, real prices for the best groundwater rights have hovered at about $700 per acre-foot. Groundwater rights located outside of the high-impact portion of the Delta area basin range in price from $300 to $500 per acre-foot (Taylor).

F. WATER LAWS, INSTITUTIONS, AND MARKET STRUCTURE IN CALIFORNIA

1. Surface Water Rights

Approximately 55 percent of California's water supply is direct and stored surface water. The legal rights to use surface water come either through having property adjacent to a river, (riparian rights) or through a legal process of appropriation.

California has developed a set of water rights that are a mixture of the old English common law and newer types of water law better adapted to the characteristics of California's arid climate. In English Common Law, the right to use water was associated with ownership of the land through or beside which the water flowed. A riparian right to use water arises for any land actually adjacent to the water source. In California riparian law, the amount of water that can be used on riparian land is limited only by the concepts of reasonable and beneficial use, and by the requirement of reasonable sharing of available supplies among riparian users. Water used under that right cannot be used on any nonriparian land. There is no filing requirement, measurement of use, or permit associated with riparian use. Riparian users normally have the highest priority to surface water in California. Riparian rights cannot be forfeited through nonuse. They account for about 10 percent of the state's water use (Phelps).

While there are large quantities of water used under riparian law, most of the surface water within the state is used under an appropriative right, whereby the appropriator, with the permission of the state through the State Water Resources Control Board (SWRCB), may divert and use allotted quantities of water from a specific source, for a designated purpose, and at a specified location and season of the year. A specific permit system governs all appropriative water uses initiated after 1914. A change in source, purpose, location or season of water use requires the

approval of the SWRCB. Appropriative rights acquired before 1914 do not require such a permit.

Appropriative rights are held in some cases by individuals or corporations, but they are much more commonly held by public entities organized for the purpose of supplying water. The federal Central Valley Project (CVP), the California State Water Project (SWP), and all local water districts with water rights fall into this category. In some cases, appropriative rights have originated with an individual and have later been turned over to local water districts. An agency must obtain an appropriative water right before surface water development may be undertaken (Bliss).

Current state law generally places in-steam uses of water in an inferior position to consumptive out-of-stream uses. The most important recognition of this is the current legal requirement that an appropriation of surface water excercise physical control of the water, for example, by diversion or use for hydroelectric generation. In a recent court decision (California Trout v. SWRCB and California Department of Fish and Game v. SWRCB), it was held that an in-stream appropriation for maintaining fish populations could not be issued. The appellate court decisions indicated that such an action would "eliminate piscatorial purposes from the balancing process prescribed by the legislature." They concluded that "A grant of prior instream appropriation rights to the department [of Fish and Game] would tie the [State Water Resources Control] Board's hands as to future uses. The water appropriated by the department would be unavailable for other yet unforeseen and overriding uses" (Phelps).

Pueblo rights are an additional and unique type of groundwater right in California. They are historical rights to river flows (above and below

surface) granted when the state was under Spanish rule. Only two pueblo rights have been judicially perfected; those for the cities of San Diego and Los Angeles (Jaquette).

2. Groundwater Rights

Prior to 1902, California applied the English rule doctrine of absolute ownership of percolating groundwater. Overlying landowners had absolute rights to use groundwater with no regard to others affected. Underground percolating water was treated the same way trees, rocks, or minerals were - all belonged to the owner of the land. In Katz v. Walkinshaw (1903), the State Supreme Court changed the law to conform to the theory of correlative rights, wherein during shortages landowners draw water to meet their needs subject to the equal rights of others drawing from the basin. Thus, overlying owners have common rights to groundwater with no priority claim among themselves.

Groundwater in California may be used under two criteria: Owners of land overlying the groundwater basin are entitled to all the water desired for use on that overlying land. This is known as "overlying use." If the groundwater basin provides excess water, that excess may be exported for use in other sites. An aquifer's "safe yield" - the average annual recharge of the groundwater basin - determines whether its groundwater may be used on nonoverlying sites. As is the case with riparian water users, if a shortage occurs (ie, if legally entitled users attempt to consume more than the available supply), withdrawals of groundwater may be limited, typically proportionate to past use, so that average withdrawals do not exceed average recharge. The state has developed its groundwater basin management laws on the principle that groundwater overdraft should be

prevented through mandatory limitations on pumping by each overlying owner, a doctrine known as "mutual prescription" (Joquette).

3. Institutions

The California Department of Water Resources (DWR) was created by statute in 1956, replacing the Division of Water Resources within the Department of Public Works. It was designed to take the responsibility for all matters pertaining to water and dams. The department was given all the authority vested in the previous agencies set up to deal with water: the Department of Public Works, the State Engineer, and the Water Project Authority (which had responsibility for planning, constructing, and operating the state water facilities). The DWR was also given broad powers with respect to water resources and their development, including gathering data (measuring and recording rainfall, stream flows, groundwater tables, and geology); monitoring chemical and bacterial content of surface and underground water; monitoring hydroelectric power; serving as Watermaster; suggesting allocation of state funds to local projects; and determining the feasibility and desireability of water projects and flood control works receiving either federal or state monies.

In 1967, the legislature merged the functions of the State Water Rights Board and the State Water Quality Control Board into the State Water Resources Control Board, which retained jurisdiction over the nine previously established regional water quality control boards. Although the SWRCB focuses on three distinct areas - water quality, water rights, and planning and research - its major influence is felt through its activities relating to water rights and water quality. The Board has grown in stature and authority along with the growing concern for environmental issues in the state. The board acts in a quasi-judicial role in determining rights

to surface water. Of particular concern to the board when making water rights determinations is the prevention of waste and unreasonbable use of water.

California's water is allocated to its users through a hierarchy of government agencies. California water supply agencies are characterized by a wide diversity of scale, and a dizzying variety of legal forms. The important private institutions are long-standing commercial water companies and mutual water agencies numbering in the hundreds. Their principle purposes are to establish rights to water use and to sell and deliver water to users. The mutual agencies sell water to members at supply costs and are thus nonprofit. The water companies sell water to customers within their service areas at whatever prices the market will bear, and the profits are distributed to stockholders as with any other private company. It is not known how much water is allocated by these private entities, but the mutual companies are more frequently utilized in irrigation, whereas the commercial companies are more heavily involved in serving urban customers.

An astonishing array of private and public institutions exist in California for the purpose of developing and allocating water resources. Numbering in the thousands, they employ operating rules established broadly by enabling legislation. These rules largely determine the distribution of economic rents connected with water use and influence the efficiency of water development and use. There are more than 1,000 regional and local agencies in California, created under 125 general and special enabling acts, each of which details the powers and limitations of the agencies created under it. Currently there are over 3,000 water suppliers in the state, of which nearly 1,000 are public water districts. About 900 of these public districts were formed under 40 general water district acts;

the remainder were individually created by the Legislature by special acts (Moore).

The public water districts that supply most of the water to agriculture in California are the reclamation districts, authorized by legislation in 1867; the irrigation districts, authorized in 1897; the water districts, authorized in 1913; and the water storage districts, authorized in 1921. Their primary purposes are to reclaim and protect lands from overflow and to irrigate lands both inside and outside the district. Irrigation districts supply, distribute, and salvage water for beneficial use. Water districts and water storage districts may produce, store, and distribute irrigation water to individual farmers.

Each of these public districts becomes in essence a nonprofit wholesaler of water. They may have water supply sources (including rights) of their own, both surface water and groundwater, or they may be contractors for water developed by the federal government through its Central Valley Project or by the state of California through its State Water Project. They are governed by boards of directors, may have powers of eminent domain, and have the power to sell general obligation bonds, levy water charges, and impose ad valorem taxes on landowners within the district. Most water service agencies function under appropriative water rights laws. Riparian users are typically small, and by definition take water only for their own use.

The agencies and individuals participating in the water allocation system in California can be stratified into four levels: on the highest level are the courts and the State Water Resources Control Board; next are the federal and state water supply agencies; then come the regional and local water agencies. The actual water users comprise the lowest level of

the hierarchy. The agencies on the first level - the courts and the State Water Resources Control Board - initially allocate the water to an agency or to an individual on one of the three lower levels. The water is then allocated down through the remaining levels until it reaches the users. While the largest portion is initially allocated to the federal and state water supply agencies and thus flows through the entire hierarchy, some initially goes to regional and local water districts, and some goes directly to users (Schelhorse).

4. Water Rights Transfers

In the past, uncertainty over water rights has made water users reluctant to consider selling or leasing their water rights to another user. To the extent that water rights are more secure, transfers between users become more feasible. Until recently one of the biggest legal impediment to water transfers has been the "beneficial use" doctrine, which limits all water rights to an amount "reasonably required for . . . [a] beneficial use." While originally enacted as part of the California constitution of 1928 in an attempt to limit the waste of water, this doctrine had the contrary effect of inhibiting voluntary reallocation of existing allotments to parties who could make better use of the water (Bliss). In 1984, the state legislature finally cleared this legal obstacle away when it enacted a new law defining the sale of water rights as a beneficial use.

Water use is heavily tied to the land. Riparian surface water use and overlying groundwater use are legally defined on the basis of land ownership. The rights to use such water cannot be transferred independent of the land title itself. Hence, purchasing a piece of land with either riparian or overlying groundwater rights is akin to purchasing the land

plus an option to use as much water as desired on that land, subject to its availability, to the constitutional requirements for reasonable and beneficial use, and other restrictions as discussed above.

The SWRCB is in a unique position to enforce the beneficial use doctrine, because it issues appropriation licenses which are limited to amounts put to reasonable beneficial use, and because it also has the power to bring judicial action to enjoin unreasonable or nonbeneficial water uses. Water agencies are therefore discouraged from transfering their rights. Fearing loss of rights if any water is found not to be beneficially used, the recipient agencies enforce the beneficial use doctrine on down the line in making their allocations; as a result, their individual customers are also discouraged from transferring their allotments.

Some provisions explicitly prohibit certain transfers. The state Water Code, as amended in 1971, prohibits districts from transferring water to outsiders unless it is declared "surplus." However, the test of "surplus" is so strict that it can rarely be met, apparently requiring the water to be unusable, at any price, by any member of the district. The enabling acts of many water districts do not provide for reallocation of water from one member to another once the initial allocation is made. Furthermore, as a general rule, riparian rights cannot be transferred for use on nonriparian land.

Appropriative rights are legally transferable, and (subject to state approval) can be sold, independent of title to land. They are the easiest water rights to transfer because the water right is recorded and the legislature has established procedures for transferring appropriative rights. The transferror must comply with the applicable provisions of water law governing a change in the purpose of use, place of use and point

of diversion. The Water Board may approve a transfer if it is in the public interest and there is no injury to other water users. In instances where the possibility for injury to other users is unknown, the Board may authorize a trial transfer not to exceed one year in order to judge the effect of the transfer. The Board may modify or revoke the trial transfer if it determines that the transfer will result in substantial injury to any water user. The Board also has the authority to approve long term transfers. However, the occasions on which transfers actually occur are limited and always subject to the uncertainty of SWRCB approval. Appropriative groundwater rights are relatively uncontrolled, except when a groundwater basin becomes overdrafted, at which time overlying groundwater users have priority, and appropriative groundwater rights can become worthless (State of California).

Groundwater in adjudicated groundwater basins may be transferred only if (after a determination of the amount needed for reasonable beneficial use on overlying lands is made) a surplus is found to exist. The surplus may be appropriated for export. Such waters cannot be exported from the area if the result will be injury to other overlying owners.

The current system for defining water rights in California presents some obstacles to developing markets to efficiently allocate water. Individual water users do not own the water rights - the water companies or districts do. In California, the Bureau of Reclamation and the Department of Water Resources are permittees of the State Water Resources Control Board, which has ultimate jurisdiction over water rights. Contractors of these agencies technically do not hold any permanent water rights beyond their contracts. They are given options to purchase water from the districts on terms specified in the contract. The district, which is bound

by contract to supply water, isn't really free to negotiate the sales of water rights or even water rentals unless it has surplus water available. In the case of State Project water, any changes in contracts or in points of diversion must be approved by the director of the Department of Water Resources. This type of adminstrative approval is likely to be difficult to obtain. The ultimate water users are powerless to make any transfers at all. The most they can do is simply forfeit their use of water, but usually they are committed by contract to take a certain amount. The result is an inflexible water allocation system.

Options to buy State Water Project water are not easily transferable. They cannot be freely bought, sold, or leased, withouth approval of the SWP, and the current policy of the SWP is to deny transfers. A series of water transfers took place within California during the 1976-77 drought, and they were all under rather special circumstances. Nearly all of the transfers occurred outside of the SWRCB appropriations system, and with few exceptions, the sale of water was made by a person or corporation with a clear direct title to the water, rather than by a water district. These transfers tended to be short-term leases negotiated in response to drought conditions (Moore).

Many of the transfers that occurred were within the Bureau of Reclamation's Central Valley Project. The Emergency Drought Act of 1977 granted the Secretary of the Interior the authority to establish a temporary water program for the purpose of minimizing agricultural losses resulting from the drought. During the program's period the Bureau purchased 46,438 acre-feet of water at prices ranging between $20 and $87 per acre-foot. The Bureau resold 42,533 acre-feet of water to various buyers at a price of $53 an acre-foot plus conveyance charges (Lee).

The Bureau administratively determined the purchase and sales prices of the water. Under the Act the purchase price could "not confer any undue benefit or profit to any person or persons compared to what would have been realized if the water had been used in the normal irrigation of crops adapted to the area." The Bureau negotiated the purchase price by considering the seller's net income adjusted by certain handling costs. Resale prices were restricted to cover the actual expenditures involved in acquiring and redistributing the water. Thus, the program rationed water allocation through a buyer preference system and marketed water simply at cost (Lee).

There is increasing pressure in California to liberalize water rights laws and permit the establishment of water markets. It is the established policy of the State of California to encourage the voluntary transfer of water and water rights The legislature has specifically stated that transfer of water or water rights does not, in itself, constitute evidence of waste or unreasonable use, method of use or method of diverson. Recent California legislation permits water and any type of water right to be transferred if the water use has been reduced or ceased because of the substitute use of reclaimed or waste water. Additionally, the law now permits the transfer of appropriated water and an appropriative water right if the use has ceased or been reduced because of water conservation efforts. These transfers must be undertaken pursuant to the provisions of law governing transfers. Under other legislation passed in 1982, any regional or local public agency authorized to serve water may now transfer surplus appropriated water to users outside its boundaries. Also, any appropriated water may be transferred if the agency and individual water users and right holders agree (State of California).

No freely negotiated market transactions were identified in California during the course of this research. Discussions with academicians involved in water research and with representatives of federal, state, and local water management organizations indicate that little market activity has occurred. State law appears to be evolving in a manner conducive to market transfers. However, as pointed out by Gardner, the operating rules of local and regional irrigation companies, water districts and other organizations have evolved to protect the existing structure of water allocation and use. Restrictions on transfer and procedures for approval of transfers present formidable obstacles to market activity (Gardner, 1984).

III. MARKET PRICES AS MEASURES OF VALUE

This research has identified three levels of concern regarding the use of market prices as measures of value. The first concern involves the general limitations economic theory places on prices as measures of value. The second concern involves the effect of specific market characteristics on the appropriateness of prices arising in those markets as measures of social value. The third concern involves practical considerations that would confront a public agency seeking to use market pricesd as measures of value. These three levels of concern are discussed in turn, along with associated implications for using market prices to value incremental flows from public lands.

Conceptual Limitations on Market Prices as a Measure of Value

A measure of value used by a public agency should fully reflect potential beneficiaries willingness to pay for incremental increases in the available water supply, as well as any positive or negative side effects (externalities) of the supply increase on individuals or groups in the region. This section outlines economic concepts helpful in understanding the role of market prices as measures of value.

Prices in a perfectly functioning competitive market will reveal buyers' willingness to pay for the marginal (the last) unit purchased. Figure 1 shows hypothetical urban, agricultural and aggregate demand functions for water at a fixed point in time. The downward slope of the curves reflects the economic concept of diminishing marginal utility. The value of the first units of water made available is high, as water in excess of precipitation is essential to economic activity in the arid West. However, as more units of water become available to a particular water user, that individual or firm is willing to pay less and less for each

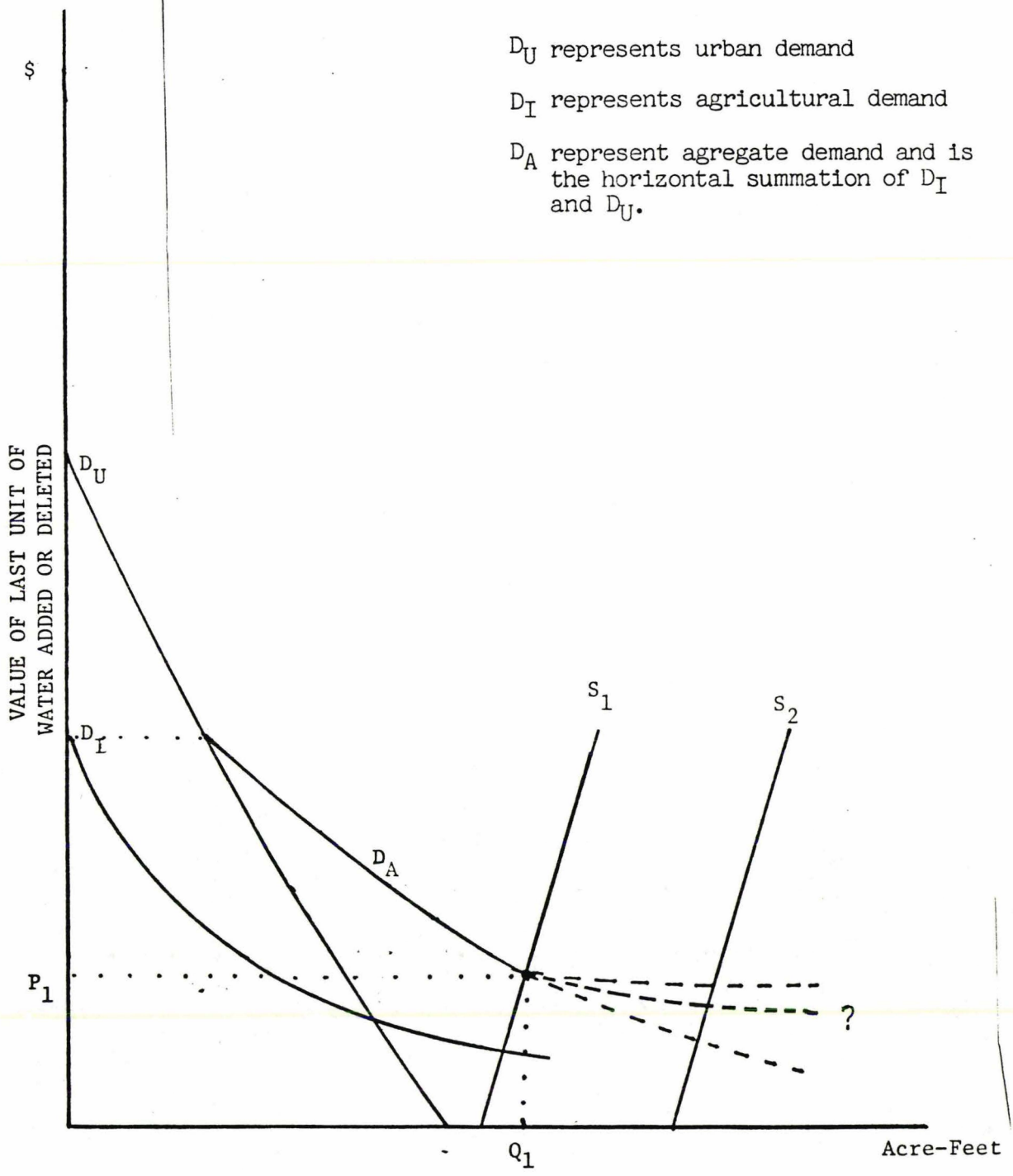

Figure 2: Water Demand and Supply

In a static framework P_1 serves as an upper bound on the marginal value of additional units of water made available by an expansion of supply from S_1 to S_2. Willingness to pay for additional supplies depends on the shape of the aggregate demand curve to the right of Q_1.

additional increment of water. Different types of water users will have somewhat different demand curves. Urban residents (illustrated by D_u in Figure 2) attach a higher value to the small quantity of water they use than most farmers would be willing to pay for that same quantity of water. However, irrigated agriculture also has a downward sloping demand curve for water (D_1 in Figure 2). The negative slope reflects the fact that the first quantities of water available to a farm are the most valuable because they will be applied to crops for which the highest returns can be obtained. Additional water will be applied to the next most profitable set of crops, and so on. The aggregate water demand curve, D_A, is the horizontal summation of the agricultural and urban demand schedules. Given a supply curve represented by S_1, the market clearing price for water occurs at P_1. Note that the market price lies <u>above</u> the unit value water users would place on additional supplies if the supply curve shifted out to S_2. Willingness to pay for units of additional water could be substantially lower than P_1, depending on the shape of the total demand curve to the right of Q_1. Data on current market transactions give very little information about the shape of the demand curve beyond Q_1. As Figure 2 illustrates, observed prices serve only as an upper bound for what current market participants might be willing to pay for additional supplies. Figure 2 portrays water demand, supply, and price formation in a static framework. As population and income levels grow or agricultural commodity prices and production technologies change, demand and supply curves shift and new prices evolve. From a dynamic perspective, observed prices emerging from existing demand and supply relationships could either overestimate or underestimate the marginal value of water supply increases in the future. A more complete discussion of demand and supply conditions surrounding water in the Southwest can be found in Kelso, Martin and Mack.

To further compound problems associated with using observed prices as measures of value, many water transactions do not take place in well-functioning competitive markets which generate prices that fully reflect the costs and benefits of transactions to all parties affected. A distinction should be made between private and social measures of value associated with resource use. A price negotiated between a buyer and a seller of a water right reflects the marginal value of the units of water exchanged to each party and thus can serve as an indicator of water value for the agents involved in the transaction. A social measure of value, however, should take into account impacts on parties affected by the transaction who were not part of the price negotiation process. This could include neighboring irrigators whose groundwater pumping costs are adversely affected, local fishermen whose trout habitat is disrupted, or future water users whose access to water will be curtailed because of current market activities.

Market Characteristics and Prices as a Measure of Value

There are several deviations from ideal market conditions which may affect the appropriateness of observed prices as measures of social values. Market prices may arise from a distribution of income and access to water which is considered inequitable or otherwise undesirable. Government agencies may be working to maintain or improve the condition of specific classes of water users. In such a setting, market prices as a measure of value may not be consistent with distributional objectives for the region. Controversies regarding Indian water rights in the Southwest illustrate the need for attention to equity issues. The next three concerns all relate to efficiency issues connected with prices as meaures of value, as contrasted with distributional implications. If water transfers positively or

negatively affect third parties and these effects (externalities) are not taken into account in the process of market transactions, then prices will not reflect full social values. Prices observed in water markets give the upper bound of an increment in supply only to the extent that those prices represent all uses of the water effected by the increment in supply. Prices are unlikely to be observed for instream water uses, such as recreation, hydropower production, and provision of aquatic habitat. If one or more water users, suppliers or government agencies can significantly affect prices or restrict transfers (imperfect competition) then observed prices may deviate from maximum willingness to pay for marginal units of water. Finally, lack of hydrologic and legal information regarding future water availability and transfers can distort market prices, as can uncertainty regarding future government programs and policies. For example, if there is some legal uncertainty regarding whether a particular water right can be transferred, individuals will bid less for that right than if its transferability were clearly estabished. Uncertainty generally reduces willingness to pay because individuals do not know exactly what bundle of rights and restrictions they are getting when they buy a water right.

The preceding discussion suggests several potential problems in considering water market prices as measures of value appropriate for use by a public agency. First, in an "ideal" market the observed price represents market participants' willingness to pay for the marginal unit of water currently available. Willingness to pay for additions to the existing water supply could differ substantially from the market price. Second, current market activities and institutions may favor some water users over others, creating inequitable access to water and income-earning opportunities. Third, market activities may generate externalities--

effects of water use and transfer poorly reflected in market prices. Some externalities arise because potential beneficiaries of water supply increases are not market participants and impacts on their well-being would not be reflected in market prices. Individuals who value non-market uses of water (such as instream flows associated with recreation and aquatic habitat) are examples of persons whose benefits from supply augmentation may be external to the market. Finally, observed prices may be influenced to varying degrees by imperfect competition and legal or hydrologic uncertainties. Table 1 summarizes characteristics of water markets which may affect prices generated in those markets.

Table 1: Water Market Characteristics, Definitions and Examples

Characteristic	Potential Effect on Prices	Examples from Case Study Areas
Equity and Conflict Resolution	Economic and legal barriers to market participation can create inequitable access to water. Water allocation decisions may serve as a form of conflict resolution and be made on political rather than market-oriented grounds. Market prices will not fully reflect distributional and political considerations.	There appear to be substantial legal barriers to Indian participation in water markets as sellers of water rights. This implies that a substantial water interest group's values are not represented in water market activities and prices. Pyramid Lake Indians have invoked Endangered Species Act to prevent lake levels from being lowered.
External Effects of Market Activities	Market prices do not take into account the values of parties external to the price negotiation process or impacts on third-parties.	In the Lower Sevier River basin of Utah, changing water use patterns by the Intermountain Power Project have improved water quality for irrigators by reducing salinity in the lower river.
Imperfect Competition and Market Restrictions	Market participants or public agencies restrict price levels and other conditions of market transfer and observed prices may reflect these restrictions.	In the Truckee River basin of Nevada the largest privately owned water utility and city governments mutually agree on the price at which they will each purchase retired irrigation rights within their service areas.
Legal, Hydrologic, and Economic Uncertainty	Uncertainty regarding future water supplies, demand, and the legal framework that governs water transfers will affect market decisions and thus observed prices.	The legal framework that governs water use and transfer in Arizona is still evolving and important legal issues related to transfer of specific types of water rights have yet to be clarified.

Comparison of Market Characteristics and Implications for Valuing Water

External Effects of Market Activities

Laws and institutions in each market area seek to minimize the impact of water transfers on neighboring water users. Well-spacing regulations, requirements for consent of others in the affected watershed and of engineering studies to demonstrate no harmful effects are examples of rules that seek to prevent externalities. Such rules are usually designed to protect traditional water uses by focusing on return flow levels for surface water or cones of depression for groundwater. They may be less effective in preventing impairment to non-market instream uses of surface water such as recreation. Nevertheless, in each market area studied there are mechanisms for protesting water transfers. However, this often involves initiation of legal action by the party seeking redress--who bears the cost of such action unless and until proved right. Market prices will not reflect negative side effects on non-market uses.

External benefical effects of market activity on third parties do occur. For example, tranfer of C-BT units from irrigators to cities (which have lower consumptive use and are upstream of irrigated areas) has increased return flows for users downstream of the cities--including the irrigators who sold the rights to the cities in the first place. Positive side effects of water transactions are not be reflected in market prices. Valuing incremental flows from public lands, the degree of negative or positive effects of market activity needs to be examined and observed, prices adjusted accordingly for use as measures of value.

Equity and Conflict Resolution

In market areas where Indians hold a significant portion of water rights, the absence of Native American participation in water market

activity implies that the values of a substantial water interest group will not be reflected in market prices. If the well-being of this interest group is affected by plans to augment water yields from public lands, observed market prices will not necessarily be an appropriate measure of value. In any region where potential beneficiaries of augmentation are not active market participants, information on the nature and magnitude of yield augmentation on these non-market participants will be necessary for a thorough assessment.

Allocation of water to a specific area or group may have political and conflict resolution value to a region, above and beyond any measurable economic benefits. Both the Central Arizona and the Central Utah projects are viewed by some observers as devices for resolving conflicts among water user groups rather than as economically rational supply development measures. Augmented flows from public lands may be allocated on the basis of political considerations rather than to the highest value use, as economic criteria would dictate. Until it is clear who will have access to increased yields (and who gets to make this allocation decision) it will be very difficult to assign a value to yield augmentation projects.

Imperfect Competition and Market Restrictions

The market areas studied differ tremendously in numbers of buyers and sellers, relative influences of particular buyers and sellers, frequency of transactions and degree of institutional restrictions or market activities. In both the Truckee River and the Lower Sevier River basins large utility companies are dominant market actors and influence water rental and sales prices. In the Gila-San Francisco Basin a large mining company was the dominant purchaser of water rights for many years. It is not possible to precisely identify the effects dominant market actors have on prices. In

some cases, they seem to function as price setters, giving price signals that are followed by other market participants. However, in the Truckee River Basin, Sierra Pacific consistently offers to purchase water rights at prices lower than other transactions in the area indicate is the going rate. Sierra Pacific is not succeeding as a price setter if its low offers are an attempt to lower market rates. With respect to implications for using market prices as measure of value, the presence and degreee of imperfect competition will need to be evaluated on a case-by-case basis. If there is a "going rate" honored by both dominant and small market participants for a particular type of water right then that is the value indicated by the market. If there is a consistent and significant discrepancy between prices emerging from negotiations involving the big actors and negotiations that do not involve them, then further study will be necessary to determine the reason for the discrepancy and which price (if any) is an appropriate reflection of water value.

The numbers of buyers and sellers and frequency of transactions affect the quantity of price data available. One might feel more comfortable using a specific price as a measure of water value if there are a large number of transactions that confirm that price as the consensus water value. If a water augmentation project will impact a region with sporadic market activity and spotty price data, use of market prices should be supplemented by attempts to determine values for water from non-market information. This could involve estimation of waters' marginal value product in various uses or inferential techniques to determine the recreation value of water.

The five states studied differ tremendously in institutional and informational conditions for market activity. Utah water rights represented by irrigation company stock are readily transferable within the service

areas of the DMAD companies with minimal paperwork and administrative proceedings, and need not be tied to a specific parcel of land. In contrast, water rights in Arizona may be transferred only under carefully specified conditions, and irrigation rights are appurtenant to land.

Within any given market area, different water rights may be subject to different guidelines on change of ownership, purpose of use, location, leasing rate. For example, Type II rights in Arizona may be transferred separately from the land to which they are appurtenant but must be sold as a whole rather than piecemeal. Arizona irrigation rights, on the other hand, are strictly appurtenant to land but a farmer may sell a portion of (rather than the entire quantity of) his irrigation rights. Colorado transmountain diversion water from the C-BT project is much more transferable than transmountain diversion water from the Frying Pan-Arkansas Project in the southern part of Colorado. The process of transferring Lower Sevier River surface water rights is quite different from the procedures required to transfer groundwater rights in the Lower Sevier Basin. These examples illustrate the fact that generalizations among states regarding marketability of water rights must be made with caution. Within each state studied there are varying degrees of restrictions on market activity that apply to different kinds of water rights. Similarities among state water laws are found in the themes of appurtenancy (not always strict) to land, requirements for beneficial use, and prior appropriation. It is not the overiding legal doctrines that differ greatly across states but rather the interpretation and implementation of those doctrines as manifested in local water management institutions.

The diversity of institutional settings in which market activities

occur has important implications for using prices as measures of value. First, there is no prior reason to believe that prices emerging in one market setting will be relevant to water values in a different setting. Second, even within the same market region, prices observed for one type of water right do not necessarily convey useful information about the value of a different type of water right. This underscores the importance of identifying the institutional structures which will govern allocation and use of augmented yields as a first step in valuing those yields. Observed market prices used to establish the value of increased flows should be the prices that emerge from an institutional setting and type of water right that closely resembles the institutions and water rights that will characterize augmented yields. Valuation of augmented flows cannot be separated from the institutions that will govern how flows are allocated and used.

Legal, Hydrologic and Economic Uncertainty

All markets studied are characterized by varying degrees of uncertainty and access to market information. In Arizona, for example, the legality of leasing Type II water rights is unclear and the question of who controls effluent use and sales is an ongoing controversy. These unclarified legal issues create an environment in which market participants cannot be sure what they are or .PA are not allowed to do and this uncertainty is a damper on expanded market activity.

The Arizona and Utah markets contrast sharly in degree of legal uncertainty and access to market information. The Arizona Department of Water Resources keeps records of Type II water rights holders which may help buyers and sellers to find one another, though there is no central clearing house for communicating bids and offers. Recorded transfers are

few in number relative to the Utah other water markets. Arizona water markets are still in the early stages of development so that potential buyers and sellers have little experience and historical information on which to base expectations about water values and market processes. In the Lower Sevier Basin irrigation company records provide information on ownership and rental patterns and company offices have served as informal clearinghouses-- helping prospective buyers, sellers, and renters to find one another. Historical records on the hydrologic cycle of the river system, along with careful reservoir management, give water users a basis on which to form expectations about future water flows and availability.

Hydrologic uncertainty is inevitable in surface water markets as no one knows what supplies will be available each year until winter snowpacks can be studied to predict spring runoff and river flows. This uncertainty is mitigated to varying degrees by storage facilities and inter-basin diversion projects. One of the principal objectives of the C-BT Project is to reduce uncertainty associated with erratic and seasonal natural stream flow. Uncertainty affects groundwater markets when there is incomplete knowledge on aquifer capacity, rates of overdraft and other factors that affect expectations regarding the long term expense of pumping groundwater. The hydrogeology of the Tucson groundwater basin is much better understood than that of the Phoenix area [Reference?] and gives decision makers in Tucson a stronger basis for developing long term groundwater management plans. Hydrologic uncertainty affects how much individuals are willing to pay for a water right. Senior surface water rights are generally more valuable than junior surface water rights more vulnerable to seasonal and year-to-year variations in flow. For example, Sierra Pacific made price offers for water rights based on their priority dates--with the most junior rights valued 25% less than the most senior rights (Landek). This example

is not typical because the actual reliability of delivery for junior and senior water rights differs very little in most areas.

Uncertainty regarding future water demand and the health of regional economies and water-using industries is all-pervasive and affects prices. Water prices rose sharply in the Lower Sevier Basin with expectations that IPP would build a large power plant in the area, bringing increased population and water demand. Prices dropped off when the power plant and development boom turned out to be much smaller than anticipated. The marginal value product of water to irrigators rises and falls with crop prices and the interest of mines and other industries in acquiring water rights fluctuates with the health of those industries. Ecnonomic uncertainty affects market prices in that prices at any point in time will reflect relevant economic expectations and conditions. With respect to valuing water, this implies that one needs to be aware of the economic factors that are influencing observed prices. A short-run rise in prices due to expectations that a new industry may enter the area would not be a good indicator of water values until prices stabilize after expectations either are (or are not) realized. In contrast, a long-term price effect due to stagnation of a water-using industry (copper mining in much of the Southwest, for example) would be a valid component of water value in the affected region.

Practical Considerations in Using Market Prices

Suppose for a moment that there are no a priori reasons to suppose that market prices are not an accurate and appropriate measure of water value. What practical problems would confront an agency seeking to use market prices to value water?

The first difficulty would be to identify and describe the various water "commodities" in the area of study. The regions analyzed in this research exhibited from two to nine different types of water rights with different legal and hydrologic characteristics and degrees of transferability. Careful study of state water law and local water management institutions is necessary to define and differentiate these commodities.

Gathering information about market prices is a time consuming task. First one must find out what transactions have occurred from records of state engineers or water agencies. Such records rarely include price data, so contact must be made with market participants or knowledgeable observers to learn about prices asociated with specific transactions. A lot of "digging" may be needed to uncover a representative price, though in some areas the "going" price for a certain type of water right is a matter of common knowledge. This is true of C-BT unit prices, for example.

As is apparent from the description of the market regions, there are a number of different prices for water arising from various types of transactions. In the lower Sevier basin prices emerge from rental and sales of irrigation company stocks and occasional purchases of surface or groundwater not represented by company stocks. In Arizona water prices arise from sales of Type II non-irrigation rights and purchases of farmland with appurtenant irrigation rights. All observed prices may vary seasonally and from year to year, as supply and demand for water fluctuates. Which, if any, of these prices (and at what points in time) are appropriate for a government agency interested in valuing water? In general, prices should be selected that most closely reflect the conditions under which increased supplies will be made available. If "new" water

represents a permanent increase in regional water supplies, then market sale prices should be used. If additional water will be offered on a year-by-year basis then rental prices may be more appropriate as a reference value. Rental prices vary across seasons and between water users and the price selected should correspond to the season and the use for which the additional water will be available. Additional supplies made available in the dry, high-demand months will n will naturally have more value than the same volume made available in high rainfall or high snowmelt seasons.

One point cannot be overemphasized--the institutional arrangements which govern diversion, instream use, and transfer of incremental flows must be carefully considered. How will new water be allocated among existing and potential users? Given the complex nature of water rights in many regions, it is entirely possible that the transactions costs associated with legal and administrative procedures required to allocate new water may exceed the value of that water.

Appropriateness and Ease of Using Prices as Measures of Value

Of all the market regions and water commodities studied in the course of this research, the observed price for C-BT units in the Northern Colorado Water Conservancy District appears to be best suited for use as a measure of water value. The "going rate" can be discovered by examining a larger number of transactions than occur in most markets, records on transactions in C-BT units are more thorough and accessible than in many areas, and the market price emerges from negotiations among many buyers and many sellers with little domination by any single market participant. Restrictions on market activity are few relative to other regions and other water commodities within the NCWCD. Legal and hydrologic uncertainties are minimal in comparison to other areas, as are external effects of market

activities. Instream flows have been recognized as a beneficial use in Colorado and their value can be reflected in market prices as different organizations (including the State of Colorado) purchase water to increase or maintain stream flow. There do not appear to be significant water interest groups who are blocked from participating in market activity.

Among all the market regions and water commodities studied, there are many candidates for the least appropriate or most difficult to use set of prices. Nearly every market is influenced to some degree by one or more of the four market characteristics discussed earlier and summarized in Table 1. In addition, the practical considerations discussed earlier affect every market to varying degrees. Prices for irrigation rights in Avra Valley, Arizona, for example, emerge from transactions between a single buyer (the City of Tucson) and a limited number of potential sellers (Avra Valley farmers). Recorded prices include land and all improvements. It is unclear what the City will do with the land and improvements and it is therefore difficult to assign a value to the water, as distinguished from the value of the whole property. The water value picture in the Tucson area is further complicated by uncertainties surrounding the Papago Tribe's water rights. The 1982 Southern Arizona Water Rights Settlement Act gave the Papago Tribe rights to 76,000 acre-feet of water annually, to be delivered by 1992. Some of this water will come from the Central Arizona Project, almost half may be treated effluent from the City of Tucson, and another portion will come from groundwater withdrawal rights. The Act provides for leasing of tribal water rights to water users within the Tucson Active Management Area under specific conditions and with the approval of the Secretary of the Interior (Ingram, McGuire and Wallace). The potential (as yet unrealized) for the entrance of a significant new market actor into Tucson area market activities creates a great deal of

uncertainty regarding future water supplies and prices. Given all of these considerations, observed prices for retired irrigation rights and agricultural properties do not appear promising as a measure of water value useful to a public agency.

Most of the other water prices studied lie somewhere between the two extremes just described in ease and appropriateness of use as measures of value. One of the clearest implications of this research is that observed prices, even where they are easily discoverable, cannot be used as measures of value until price formation processes and market characteristics have been thoroughly examined. Such an analysis will typically find that observed prices deviate from a social value of water, suggesting that market information be supplemented by other measures to assess water values.

Other Indicators of Water Values

Techniques are well-developed for estimating the marginal value product of water in agriculture production. Due to the absence of a wide range of observed water prices for agriculture, studies on the agricultural value of water generally rely on programming methods. Kelso, Martin, and Mack (1973) derived aggregate marginal demand curves for irrigation districts in Arizona using linear programming analysis of representative farms, and used these demand functions in their discussion of the value of water in agriculture and related sectors of the economy. Howitt, Wilson, and Adams (1982) used a quadratic programming model of field crop production to derive a demand schedule for irrigation water in California's Central Valley. They note the importance of correctly-determined price elasticities for water allocation policy. Gardner and Miller compute the marginal value product of irrigation water in the C-BT service area by a

residual computation method, substracting the costs of all inputs except water from gross farm income.

A number of researchers have developed models of municipal water demand. Howe and Linaweaver, in an early study using data from twenty-one metropolitan areas, found that price elasticity of demand differed substantially between indoor and outdoor use, as well as between eastern and western metropolitan areas. Methods of estimating urban demand functions continue to be refined. Martin et al. critique the use of conventional regression analysis to estimate demand in areas were water rates follow a block rate schedule--an increasingly common pricing practice. The authors outline an interactive regression procedure which produces unbiased estimates of demand function coefficients in a block rate setting. Based on these estimates, the study concludes that real price is an important (though not the only important) component affecting consumer demand in Tucson.

Methods for valuing water in recreational and other instream uses are much less well developed. Many authors mention in-stream benefits related to water yield enhancement, recreation, energy, and fish-habitat, but few have analyzed these components of water value in detail. Krutilla, Bowes, and Sherman (1983) describe a procedure to estimate the in-stream energy value of increased flow and discuss in-stream amenity values. This study also develops and demonstrates--using the Colorado West Slope forests as a case study--a framework for evaluating the benefits and costs of water augmentation activities. Martin and Cory (1984) comment on this study, emphasizing the importance of comparing water augmentation projects to agricultural water transfer policies in term of both net social benefits

and the incidence of benefits and costs on taxpayers, agriculture, and municipal and industrial interests.

Lack of household, industry, and farm level data on water use is a major constraint on widespread use of water demand functions as an aid in valuing water for agricultural, industrial and residential uses. Lack of a widely accepted methodology, along with absence of data, make estimation of instream water values difficult. Therefore, the recommendation that market data be supplemented by non-market information on water values will be difficult to implement. However, inferential and hypothetical valuation techniques have been applied to wildlife, scenic amenities, recreation opportunities, and air and water quality. Research attention needs to focus on adapting these methods to valuing water in alternative uses.

IV. SUMMARY AND CONCLUSIONS

The appropriateness and practical feasibility of using market prices as a measure of water's value must be determined on a case-by-case basis. Observed prices in a well-functioning competitive market can serve as an upper bound on the marginal value of additions to regional water supply. If the additional volume of water made available by changes in public land management is small relative to the region's total supply, then observed prices may be a close approximation to marginal willingness to pay (by current market participants) for additional water supplied. If the additional volume of water is significant relative to existing supplies, valuation is more complicated. Estimates of water's marginal value product in out-of-channel uses (if any) to which the additional water will be put should be considered, along with estimates of the value of any additional in-stream flows--perhaps for recreation or fish and wildlife habitat. Marginal in-stream and out-of-channel values could differ substantially from market prices and would need to be estimated using techniques designed for those purposes. For example, Kelso, Martin and Mack develop and apply a methodology for valuing incremental changes in water availability to irrigated agriculture. One would want to also consider the possibility that substantial increases in water supply could attract new water users into a region and change the structure of demand for water, making existing market prices largely irrelevant.

In considering the conditions under which market prices are generated, a public agency interested in valuing water must examine the nature of the price formation process. Are prices set or constrained by government policies or important market participants? If so, the price may deviate substantially from maximum willingness to pay for additional units of water. Do existing water transfers and market transactions impose damages

on third parties which are not accounted for in prices and in the institutions that govern transfers and sales? If so, observed prices do not incorporate all of the costs and benefits associated with water transfers and would need to be adjusted accordingly. If market activities appear dampened by institutional uncertainties (as in developing Arizona water markets) that are likely to be resolved by new laws and policies, then current prices may be a distorted measure of willingness to pay for water. However, if legal and hydrologic uncertainties are unlikely to be clarified and will affect use of newly available water, then prices generated under these uncertainties may be applicable in valuing increases in water supply. The role of institutions and management policies will inevitably be a central issue in valuation.

After evaluating the appropriateness of using existing prices as measures of value, one must consider the impacts of the supply enhancement project itself. Will changes in public land management to increase water yields affect the well-being of regional residents, aside from the effects on water supply? Side-effects (positive or negative) involving environmental quality, employment and recreational opportunities, or wildlife would have to be considered in adding up the costs and benefits of a water yield enhancement project. Will the project affect relative income and access to water among farmers, municipalities, Indian nations, or other major water users? The project may have additional value if it benefits specific water users, and thus aids in resolving conflicts or accomplishing distributional objectives for the region.

As illustrated by the comparison of water markets in five western states, western water transfers take place under diverse institutional and hydrologic conditions. Water markets are characterized by various degrees

of imperfect competition, third-party impacts, uncertainty and distributional effects. These characteristics affect the appropriateness of prices generated in those markets for use as measures of value by public agencies. While nearly all market prices will deviate somewhat from an ideal measure of willingness to pay, observed prices can serve as a reference point for valuation. In most cases other valuation techniques would be useful in supplementing the information supplied by water market transactions. Valuation of any non-market effects (on wildlife and recreation, for example) of water yield augmentation should be considered, along with estimates of water's value marginal product in various uses. The importance of the institutional setting cannot be overemphasized. Information regarding how much new water will be available to various user groups (and at what prices), and other conditions related to use and transfer of this water must be incorporated into the valuation process. In closing, estimating benefits of yield augmentation is only one part of the picture. The overall merits of a water supply enhancement scheme must be gauged by comparing estimated benefits to total costs associated with the project.

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APPENDIX A

Water Rights in Southern Arizona

Exempt Groundwater Wells. Two classes of groundwater use are not regulated by the Department of Water Resources under the authority of the Groundwater Management Act of 1980. Exempt groundwater wells are limited to a flow rate of 35 gallons per minute for nonirrigation domestic uses, and a volume of ten acre-feet per year for commercial use or for the irrigation of less than two acres of land. The user does not have to put the water to beneficial use to preserve the right to use an exempt well. Permits for exempt wells are not transferable.

Temporary Groundwater Withdrawal Permits. Several types of acceptable "temporary" commercial and industrial uses for water are recognized by the Groundwater Management Act of 1980. Individuals and entities may apply for the temporary right to withdraw groundwater without owning or acquiring a preexisting water right. The Department of Water Resources grants a limited number of temporary groundwater withdrawal permits for periods of 10, 20, or 50 years. The permit the user does not have to put the water to beneficial use to preserve the right to withdraw it.

Temporary groundwater withdrawal permits may not be transferred.

Grandfathered Irrigation Rights. Rights to irrigate lands within designated AMA's are based upon historic patterns of use. Guidelines for determining eligible irrigation acreage are specified in the Groundwater Management Act of 1980. Irrigators do not have to put their water rights to beneficial use to preserve them. The water duty, or allowable rate of water use per irrigated acre, is defined by each AMA and the total water right on each landholding is a multiple of the water duty and the irrigable

acreage. Over time, the local AMA's will gradually reduce the total quantity of water assigned to each irrigation right as state water conservation requirements become more stringent.

Grandfathered irrigation rights are not transferable off the land to which they are appurtenant. Irrigation water rights assigned to one parcel of land may not be used for the irrigation of any other land, except for other legally irrigable acreage on contiguous properties under the same ownership. Grandfathered irrigation rights are conveyed to new owners upon the sale of appurtenant farmland. Nonagricultural users may purchase land with grandfathered irrigation rights and converted them into Type I nonirrigation rights.

Type I Grandfathered Nonirrigation Rights. Irrigation water rights appurtenant to retired agricultural lands may be converted into Type I nonirrigation water rights, under guidelines established in the Groundwater Management Act of 1980. The water does not have to be put to beneficial use in order to preserve the right. The quantity of water assigned to the right is a function of the quantity of the irrigation right at the time of retirement. Once an irrigation water right is converted to nonirrigation use, the volumetric quantity of allowable water use is permanently fixed.

Type I grandfathered nonirrigation rights are not transferable off the land to which they are appurtenant, but the water associated with the right may be transported off the land for nonirrigation purposes. Type I water may be transported within, between, or outside of existing AMA's without liability or injunction. Prices paid for grandfathered irrigation acres for the purpose of Type I conversion currently range between $1,000 and $2,600 per acre-foot.

Type II Grandfathered Nonirrigation Rights. A small number of nonirrigation water rights defined under the Groundwater Management Act of 1980 were originally developed for commercial or domestic use and are not associated with the retirement of irrigated acreage. The quantity of the water right is permanently fixed and the user does not have to put the water to beneficial use in order to preserve the right.

Type II nonirrigation grandfathered rights are transferable off the land to which they are appurtenant, and may be transferred anywhere within the same AMA. Some restrictions may apply on the type of use to which some of the rights may be applied, and the water right is not divisible. Arizona law does not explicitly state whether the water from a Type II right may be transported off the land to which the right is appurtenant. Typical prices paid for Type II nonirrigation water rights currently range between $400 and $700 per acre-foot.

Service Area Groundwater Rights. Legally sanctioned nonagricultural water service organizations are permitted to withdraw groundwater for use within their service areas, under guidelines established in the Groundwater Management Act of 1980. The water purveyor does not have to put its water resources to beneficial use in order to preserve its rights. There is no specific limit on the quantity of groundwater that may be withdrawn under a service area right, although total water use is regulated by per capita use restrictions imposed by the local AMA.

Service area rights are not transferable, and the transportation of groundwater withdrawn under the right is confined to the boundaries of the service area. However, new service areas may be initiated by first securing a Type I or Type II nonirrigation water right, or by leasing water

available under either right. Once water service is established, the state of Arizona will then permit the purveyor to develop their own water rights on service area lands.

Adjudicated Surface Water Rights. Surface water rights in Arizona are governed under the legal doctrine of prior appropriation. The individual water user, or the water service organization in behalf of the user, must put the right to beneficial use in order to preserve it. The quantity of the water right never varies, but the available water supply is subject to the natural and uncertain hydrologic cycles of the stream system.

Adjudicated surface water rights are transferable off the land to which they are appurtenant. Transfers must be approved by the Department of Water Resources and be consented to by any and all water service organizations within the same watershed as water right in question. A recent purchase of surface water rights cost about $1,200 per acre-foot.

CAP Water Rights. The rights to CAP water are not owned by individual water users, but by the state of Arizona. Individual water service organizations contract for the delivery of CAP water through the CAWCD. CAP water is a fairly reliable long term supply for Indian and M&I users, but will be no more than a residual source of supply for agriculture.

Neither rights to CAP water service nor CAP water are transferable off the land or from out of the service area to which they are appurtenant. However, agricultural allocations of CAP water may be converted to M&I allocations at the rate of one acre-foot of CAP water per acre of retired irrigation land. CAP allocations converted from agricultural to M&I use enjoy the same level of delivery security as all other M&I allocations.

Sewage Effluent. The legal status of sewage effluent is currently in flux, because the state water code is mostly silent on this matter. A

recent court case decided that effluent was not subject to regulation under the existing state laws, effectively making effluent the most legally flexible water resource available in the area at the current time. Prices for sewage effluent currently range between $5 and over $300 per acre-foot.

APPENDIX B

Water Rights in Northeastern and Southeastern Colorado

Decreed Groundwater Rights. Most groundwater rights are junior to most surface water rights. Under state law groundwater users cannot withdraw water beyond certain low limits without submitting a "plan of augmentation" to the state water authorities. The augmentation plan is designed with the intention of compensating local surface water supplies that are thought to be impacted adversely as a result of excessive groundwater withdrawals.

The marginal quality of much of the groundwater resources, the inconveniences of developing acceptable augmentation plans, and the relatively low cost of most alternative surface water supplies make these rights the least transferred water rights in Colorado. Few groundwater rights have been marketed within either study area. Groundwater is sometimes leased and transported for prices currently ranging between $100 and $200 per acre-foot.

Decreed Direct Flow Rights. The quality and usefulness of direct flow rights is highly variable. They are subject to the constraints of their priority relative to other decreed flow rights and to the hydrologic limitations of the stream system. Access to direct flow rights may also be limited to only certain times of the year. There are no volumetric restrictions on the use of originally decreed flow rights, so long as no water is "wasted."

Decreed surface water rights are often difficult to transfer. Any alteration of the point of diversion, place or purpose of use requires proceedings before the water court. A determination must be made of the

historic consumptive use of the right and, barring any other unforseen protests or legal difficulties, the right may then be changed. Some water users, anticipating submitting an application to sell and transfer their rights have attempted to increase their level of use in order to bias the consumptive use limitation upwards.

Decreed Storage Rights Stored water rights similar to direct flow rights in that they are subject to relative priority and to the physical limitations of the stream system. They also have a precise volumetric determination. The rights are more flexible than direct flow rights because the water may be used any time as the user sees fit. Storage rights are also valuable because the storage space available in a reservoir may be used to store any water, not only the water specified in the decree. Users typically acquire storage rights not only for the water right itself, but to capture and store some of their direct flow ically acquire storage rights not only for the water right itself, but to capture and store some of their direct flow rights as well.

Storage rights are transferable subject to the findings of the water court. Since the rights must be associated with a physical structure, the reservoir, transfers of these rights usually only involve a change in ownership and not a change in location. Prices for reservoir rights recently sold in in southeastern Colorado ranged between $400 and $500 per acre-foot of storage space.

Transmountain Diversion Water. There are no individually decreed transmountain diversion water rights, although many such rights are closely held by one or two water service organizations. Transmountain diversion water rights available "publically" in the two study areas consist of those held by two Bureau of Reclamation projects (Fry-Ark and C-BT), one mutual

stock company (Twin Lakes), and one local project financed by a consortium of municipal organizations (Windy Gap). Transmountain diversion water is distinguished from native flow rights by the fact that users of this water have no return flow obligations to downstream appropriators. Transmountain diversion water may be used, reused, and sold to extinction, so long as it can still be identified.

Transmountain diversion water rights may be transferred freely anywhere within the service area of the project or the water company that manages the water. The degree of control that may be exercised by the individual water users over the primary and return flow water rights, however, is a matter left up to the governing board of the water project. Some projects exercise very tight central control over the disposition of the water and water rights, while others are much more liberal. Fry-Ark water is not transferable or marketable at all. C-BT, Twin Lakes, and Windy Gap water are very marketable. Of the three, C-BT water is probably the least flexible and Windy Gap water is the most flexible. Prices for transmountain water rights currently vary between $950 and $15,000 per acre-foot.

Transferred Native Flow Rights and Transmountain Return Flows. Although the origins of transferred native flow rights and transmountain return flow water are very different, they are functionally the same type of water right. Both are "recycled" from other water rights. Both may legally be used and reused or sold and transferred to extinction, as long as they can be identified. Both are relatively new legal concepts and neither have been exploited in any significant way to date. Both are beginning to receive increasing attention among water resource managers and in the water courts.

Water Company Water Rights. Water company water rights may be a bundle of decreed flow rights, storage rights, groundwater and transmountain diversion water. Although there is no specific volumetric limitation on the use of water by the company as a whole, individual users are generally limited to the use of the quantity of water allocated to them by the company. This volume is based on the individual's proportionate interest in the company, usually represented by shares of mutual stock.

When kept within the service area of the company which manages them, water company rights are among the most flexible of all water rights. Most transfers may be effected by a simple transfer of paper stock. There are only two circumstances under which a transfer of water company rights need go through proceedings before the district water court. One is if the proposed transfer involves a change in the purpose of use of the water. The other is if the proposed transfer would remove the water from its decreed service area.

Within the broad category of water rights managed by water companies there are some kinds that are more flexible and marketable than others. Generally rights represented by water companies with larger service areas are more marketable than rights represented by companies with smaller service areas. The size and quality of the storage facilities is also important. Water companies that have good storage facilities can hold water for their users until it is needed, and may have the capacity to carry over unused water to subsequent seasons. Companies with inadequate storage facilities may not be able to supply water on call. Observed prices for water company stock vary tremendously.

These two aspects of water company rights, the size of the area over which the rights can be moved to and used (market area), and the degree of

control that a water user has over the timing and use of the water rights (flexibility) are strong determining factors in establishing the marketability and the relative market value for water company water rights. It is these two factors which make C-BT and Twin Lakes water stock the most valued and consequently the most high-priced water resources in the front range area of eastern Colorado.

APPENDIX C

Water Rights in the Truckee and Carson River Basins of Nevada

Exempt Groundwater Wells. Groundwater rights that are not regulated by the state engineer are small in size and few in number. They have no signigicant impact on the market for other types of water rights.

Appropriated Groundwater Rights. Appropriated groundwater rights are regulated by the state engineer but are not subject to the Orr Ditch Decree of 1944. Water quality is highly variable, ranging from good to very poor. Market demand for groundwater rights is also highly variable. In some areas in and near the Truckee Meadows rights have not sold for more than $50 per acre-foot. In the Fallon area of the TCID, groundwater rights are said to be worth about $300 per acre-foot. In some groundwater basins outside the Truckee Meadows where water is very scarce and development pressures are strong, groundwater rights have been sold for up to $10,000 per acre-foot.

TCID Surface Water Rights. The TCID has approximately 400,000 acre-feet in federally-decreed surface water rights on the Truckee and Carson Rivers. In an average year it uses about 375,000 acre-feet, which is almost equally divided between the two river sources. Within the last few years the water used on district lands have been recognized as a right of personal property which may be bought and sold freely, at least within the district itself. There are many uncertainties about the possibility of transferring water rights into or out of the district, and the likelihood of such transfers taking place in the foreseeable future is very small.

Pyramid Lake Indian Surface Water Rights. The Pyramid Lake Indians have 30,000 acre-feet of irrigation water rights allocated to them under the Orr Ditch Decree, of which only a fraction are actually being used.

The average of 300,000 acre-feet of native Truckee River and return flow water that enters Pyramid Lake were never formally allocated. Over the years the rate of consumptive use of the Truckee River has increased and flows into the lake have fallen, endangering the habitats of the native fish species upon which the Indians' livelihood depends. Nonmarket strategies have been relied upon in their attempt to secure adequate levels of flow from the Truckee River into Pyramid Lake. In particular, the Indians have successfully used the provisions of the Endangered Species Act to win favorable decisions on their behalf by the Department of the Interior and the federal court system. In the late 1970's they successfully preempted all of the water in Stampede Reservoir for use in protecting fish habitat. Since the early 1980's this has led to a scramble among M&I users to find alternative water supplies in the Truckee Meadows.

Non-TCID and Non-Indian Truckee River Irrigation Rights

Irrigation rights have been the primary source of new water rights for M&I use in the Truckee Meadows since the Orr Ditch Decree was handed down in 1944. Sierra Pacific has acquired and transferred approximately 38,000 acre-feet of water rights over the past 40 years, most of them at real prices ranging between $50 and $160 per acre-foot.

Since the current water crunch hit in 1979, prices have shot up dramatically and Sierra Pacific has all but bowed out of the water market entirely. However, the company is still considering the possibility of buying 9,400 acres of land and 10,000 acre-feet of water rights in Sierra Valley, California. Local opposition to acquiring the water rights in California may prevent their transfer. They are also very expensive rights. Costs could run as high as $2,000 per acre-foot.

Under the Public Service Commission's Rule 17, SB 323, and the new city ordinances, water rights in the Truckee Meadows area will now be acquired mostly by individuals developers, dedicated to the appropriate city or county government, and then leased for 99 years to Sierra Pacific in exchange for water service on the new development. About 28,000 acre-feet of Truckee River irrigation rights are still in use in the Truckee Meadows and are theoretically available for transfer into the Sierra Pacific service area.

Most of the actively used irrigation water rights in the Truckee Meadows area are still located outside the service area of Sierra Pacific. These rights are relatively easy to transfer to the utility company and they are acceptable in exchange for water service on developments either within Sierra Pacific's existing service area or on developments on lands that are about to be annexed into the service area. Prices for these water rights currently range between $1,500 and over $2,000 per acre-foot. Water rights on lands already within the service area of Sierra Pacific are somewhat less valuable, since they may only be exchanged for water service on projects within the existing service area boundaries. Prices on these rights range between $1,000 and $1,500 per acre-foot.

Unused Truckee River Irrigation Rights In addition to the active irrigation rights potentially available for acquisition by Sierra Pacific, another estimated 32,000 acre-feet of unused irrigation rights exist appurtenant to lands currently receiving water service by Sierra Pacific. About half of the water rights are in small holdings of less than 10 acre-feet, and about half are in holdings of more than 10 acre-feet each. Most of the larger water rights are either being held for use in developing properties or are for sale at prices in excess of $1,000 per acre-foot.

Many of the smaller lots of water rights may eventually be acquired by the cities of Reno and Sparks or by Washoe County under the SB 323 program for $422 per acre-foot. The low price takes into account the relatively high transactions costs per unit involved in transferring small quantities of water rights.

APPENDIX D

Water Rights in the Gila-San Francisco Basin of New Mexico

Exempt Groundwater Wells. Any water user in New Mexico who is not within the service area of an established water purveyor may register with the state engineer to drill a well for domestic purposes only. Exempt wells in the Gila-San Francisco basin are further restricted in that the water from these wells may not be used for any purpose outside the house. Exempt wells in the Gila-San Francisco are also known as "non-consumptive use" wells, because it is assumed that all of the water used is returned to the local acquifer through the household septic system. Since anyone may register for a non-consumptive use well, there is no market for the right.

Domestic Well Rights. A limited number of well rights in the Gila-San Francisco have characteristics similar to exempt well rights found elsewhere in New Mexico. Domestic well rights are limited to three acre-feet per year and may be used for household purposes and for the irrigation of not more than one acre of land. Domestic well rights have four characteristics which distinguish them from other regulated water rights in the Gila-San Francisco basin: they apply exclusively to groundwater, they are not divisible, they never change in quantity if they are transferred, and the water does not have to be put to beneficial use in order to be preserved. Current prices for domestic well rights range between about about $3,000 and $4,500 per right, or about $1,000 to $1,500 per acre foot.

Irrigation Groundwater or Surface Water Rights. Irrigation rights are characterized within each of the seven major Areas in the Gila-San Francisco by three volumetric measures: the maximum annual quantity that

may be used per acre of land, the maximum rolling 10-year average quantity that may be used per acre of land, and the consumptive use portion of the right. The consumptive use portion only affects the user if the water right is transferred to a different Area of the basin.

Irrigation rights may change their point of diversion from a surface water to a groundwater source. They may be transferred either in whole or in part. Their use may be changed to domestic, municipal, or commerical-industrial purposes. The quantity of the right may change as a result of the change in location or purpose of use. Prices for irrigation rights are currently range between about $1,300 and $2,000 per acre-foot.

Commerical and Industrial Groundwater or Surface Water Rights. Rights which were originally decreed as commerical or industrial water rights may be transferred to other commercial or industrial uses, but may not be tranferred for use in irrigation. Most uses are limited to the amount of the consumptive use portion of the right. Little or no price data exist on the sale of this type of water right.

Multi-Purpose Groundwater or Surface Water Rights. Some water users, the Phelps Dodge Corporation being the prime example, are permitted to use their water rights for more than one purpose. The quantification of the right depends upon its particular application. Few, if any, multiple use water rights have ever been transferred.

APPENDIX E

Water Rights in the Delta and Lynndyl Areas of Utah

Decreed Groundwater Rights. Groundwater rights are not volumetrically quantified in Utah, but are defined in terms of flow rates. Certain small wells with low flow rates are exempt from regulation by the state engineer and may be drilled virtualy anwhere the applicant chooses. Groundwater rights in larger wells may only be developed in basins still open to appropriation.

Since groundwater rights are not volumetrically quantified, their transfer may be complicated if the change in location and purpose of use is significantly different from the original appropriation. Under those circumstances, the state engineer usually has to make some determination of the historic level of consumptive use. This provides a measure of how much water may be developed in the new location without impairing existing rights. The state engineer's determination may have an unpredictable outcome on the value and transferability of the water right.

In the closed Delta area groundwater basin the state engineer has declared one portion to be a "high impact" area, where groundwater transfers are very restricted. Groundwater rights prices differ depending upon whether they are in the high or low impact area of the basin. Prices in the high impact area are currently around $700 to $900 per acre-foot, while in the low impact area they run between $300 and $500 per acre-foot.

Irrigation Company Water Stock. Water stock in the DMAD companies is extremely marketable within the combined service areas of the four companies. Any irrigator within any service area may own and use water stock in any one of the companies. Water stock is freely transferable

without any proceedings before the state engineer and without authorization from any other party. Seasonal rentals of water or water stock are common and easy to accomplish, and transactions are direct and informal.

Prices on the water stock tend to be low, since the quality of the water precludes its use for almost any purpose except irrigation. Apart from the brief speculative boom that drove stock prices up to three times their normal levels during the IPP water purchases, real prices have remained fairly constant at about $350 per acre-foot for several years. Real rental prices vary significantly from year to year, although they appear to have peaked in the 1960's. The most recent rental market prices were about $8 to $8.50 per acre-foot.

APPENDIX F

SUMMARY OF PRICE DATA

All prices are reported in 1984 dollars per acre-foot of water transferrable to the purchaser, except where otherwise noted. In many regions, due to the scattered and informal nature of records on water market transactions, it is not possible to determine what proportion of total market transactions in a particular year are represented by the prices reported here. There was no possibility of taking a random sample approach in collecting price data. Prices are generally not a matter of public record and the information reported comes from individuals and organizations who were willing to divulge information on market activities and prices, and who had retained written records which enabled them to provide detailed price and quantity data on transactions over the last two decades. The identity of buyers and sellers in individual transactions is confidential, unless the transaction has been publicized elsewhere--as in the case of Scottsdale's purchase of Planet Ranch (Arizona) or Sierra Pacific acquisitions of Truckee River Rights (Nevada).

Table 2

Prices for Avra Valley Farmland and Water Rights Purchased by the City of Tucson

Date	Total Price (Nominal Dollars)	Grand-Fathered Irrigated Acres	Type I Rights Acre-Feet	Real Price/af
3/71	156,000	307	921	424.31
5/72	765,000	1,428	4,284	435.54
11/72	324,000	660	1,980	399.12
1/75	220,000	303	909	465.42
8/75	333,600	371	1,113	576.40
12/75	359,112	437	1,311	526.77
12/75	336,500	296	888	728.73
1/76	80,000	92	276	527.02
1/76	120,000	152	456	478.47
1/76	175,000	261	783	406.36
1/76	552,500	628	1,884	533.20
1/76	470,000	453	1,359	628.80
3/76	457,500	470	1,410	589.95
3/76	458,500	469	1,407	592.49
3/76	281,050	263	789	647.65
3/76	1,231,000	1,287	3,861	579.69
3/76	1,420,000	1,540	4,620	558.84
5/76	144,950	159	477	552.51

Table 2, continued.

Date	Total Price (Nominal Dollars)	Grand-Fathered Irrigated Acres	Type I Rights Acre-Feet	Real Price/af
5/77	905,000	811	2,433	630.46
2/79	193,500	140	420	648.89
6/79	332,750	221	663	706.89
1984	1,750,000	633	1,899	921.54
1984	890,000	273	819	1,086.69
1984	2,250,000	1,005	3,015	746.27
1984	342,000	184	552	619.57
1984	600,000	300	900	666.67
1984	1,700,000	772	2,316	734.02
1984	1,450,000	608.2	1,824.6	794.69
1984	1,860,000	620	1,860	1,000.00

In addition to these sums, Tucson has spent about $100,000 over the past four years buying equipment and making capital improvements. They have been spending about $150,000 per year maintaining the lands they bought; this will probably be increasing five or ten percent per year as they buy more land.

Table 3

Pinal County Farmland and Water Rights Purchases By the City of Mesa

(all properties were acquired in the spring of 1985)

Total Price	Grand-Fathered Irrigation Acres	Type I Rights Acre-Feet	Real Price/Af
892,125	305	828	1077.45
2,370,350	849	2385	993.86
3,450,000	1350	3792	909.81
1,526,000	544	1527	999.35
1,750,000	638	1755	997.15
1,610,000	618	1542	1044.10
351,000	130	353	994.33
1,536,000	575	1533	1001.96
2,944,800	1636	3462	850.61
3,957,500	1583	3852	1027.39
3,000,000	1128	2944	1002.00
4,500,000	1466	4089	1100.51
1,185,000	464	1290	918.60
680,000	283	720	944.44

Table 4

Prices for Type II NonIrrigation Grandfathered Rights

Date	Acre-Feet	Price / af
	(Tucson AMA)	
?	4	2000
10/84	25	600
10/84	70	600
11/84	25	600 - 700
12/84	70	400
1985 (?)	152	200 - 600
2/85	20	400
5/85	?	600 - 700
6/85	16	700
7/85	14	650
	(Phoenix AMA)	
1985	10	leased for $200/yr

Table 6

Sales of Twin Lakes Water Stock

(1.1 af/share, except for City of Aurora, 1.0 af/share)

Date	Shares	Acre-Feet	Price/Af
1970	+- 29,000	+- 32,000	+- 905
3/71	237.33	261.06	1,399.60
1972	5,381.08	5,919.19	2,443.18
8/1/72	6,011.66	6,612.83	2,443.18
1/15/73	5,464.50	6,010.95	2,487.50
12/72	5,464.50	6,101.95	2,487.50
12/72	5,919.98	6,511.98	2,442.50
3/19/73	2,500.00	2,500.00	2,674.42
6-8/76	455.05	500.56	2,065.45
10/76	15,260.16	16,786.18	2,312.73
5/79	114.00	125.40	--------

It is reported that there have been some transactions of Twin Lakes water stock at prices ranging between $3,000 and $15,000 per share. Shares are sold in very small quantities for groundwater augmentation plans in mountain developments. Many new homeowners in these areas find it cheaper and easier to pay high sums for Twin Lakes Stock rather than pay less money for local stream rights, and have to go through water court to get the transfer approved.

Table 7

Rentals of Twin Lakes Water by Pueblo West

Year	Acre-Feet	Price/Af
1982	1,196.88	22.60
1983	120.00	31.25
	300.00	22.41
	850.00	20.94
	80.00	18.85
	200.00	18.75
	35.00	15.62
	1585.00	
1984	280.00	18.00
	51.00	12.00
	331.00	
1985	240.00	18.00
	60.00	12.00
	200.00	8.00
	1180.00	2.70
	1680.00	

Table 8

Sales and Leases of Other Water and Water Rights in Southeastern Colorado

Storage Rights in Tourquoise Reservoir

Date	Acre-Feet of Storage Space	Total Cost	Cost/Af
December, 1983	5,000	2.0 million	400
January, 1984	5,000	2.0 million	400
May, 1984	17,470	8.3 million	475

Sale of Direct Flow Rights in the Colorado Canal Company

Date	Acre-Feet	Cost/Af
1985 (?)	5,000	2,200
future (option)	5,000	2,300

Miscellaneous Sales and Leases

Date	Quantity and Type	Cost
June, 1969	option to lease 2,500 af/yr of Homestake	1,000/af for option 3/af to lease
pre-1971 1971	Catlin Canal Company	40/af 125/af
1985	Storage and flow rights in the Colorado Canal, Henry, & Meredith Co's.	1,585/af - 1,870/af
1985	Various annual leases for groundwater, return flow, or untreated municipal water	100/af to 250/af

Table 9. Representative Water Rights Prices in Northeastern Colorado

Year	C-BT	N. Poudre	Pleas. Vlly. Lake & Canal	Farmers Ditch	Anderson	East Boulder	Boulder & White Rock	North Boulder	Smith-Goss	Howard	Wtr Supply & Storage
1961	135										
1962	150	115									
1963	200		125								
1964	300	150	125								
1965	430	275	125		145						
1966	470		122	150	350						
1967	525	300	120	175	350	1825					
1968	575	400	110	175	400	1735					
1969	800	500	105	200	550	1625	175	275		760	
1970	925	540	100	290	550		335	260			
1971	925	525	95	240	535		325	250	385		
1972	925	525	90	235	510	1435	310		375	670	500
1973	950	650		225	500		310		350	635	
1974	1025	900			500						
1975	1075	830		250		1200		260		1050	
1976	1200	900									
1977	2225			275		1130					
1978	2750	1720		260	330						
1979	3400	1410		240							
1980	3400	625		235	545				190		
1981	3000			215	950				570		
1982	1900	350		230	830				540		
1983	1600	825		250	1010						
1984	1300			240							
1985	1050										

Table 10

Representative Rental Prices for Selected Water Rights in Northeastern Colorado

Year	Name of Water Company	Price/Af
1963	Colorado-Big Thompson	17.00 - 20.00
1964		17.00 - 20.00
1965		16.00 - 18.00
1967		16.00 - 18.00
1968		14.00 - 16.00
1969		14.00 - 16.00
1970		13.00 - 15.00
1971		13.00 - 15.00
1972		12.50 - 14.00
1973		12.00 - 14.00
1974		11.00 - 13.50
1975		9.50 - 11.50
1976		9.00 - 11.00
1977		10.50 - 13.50
1978		9.50 - 16.00
1979		8.50 - 14.50
1980		9.00 - 16.50
1981		14.00 - 17.00
1982		10.00 - 20.00
1983		8.50 - 18.00
1984		8.00 - 17.00
1985		12.00 - 18.00
1964	North Poudre Irrigation	11.00
1965		14.00
1966		13.50
1967		14.50
1968		14.00
1969		?
1970		?
1971		7.50
1972		10.50
1973		?
1974		?
1975		11.50
1976		?
1977		14.50
1978		10.50
1979		12.90
1980		13.50
1981		17.00
1982		16.50
1983		18.50
1984		18.00
1985		18.00

Table 10, continued

Year	Name of Water Company	Price/Af
1980	Water Supply and Storage	12.00
1981		13.00
1982		15.50
1983		15.00
1984		15.00
1985		14.50
1980	Pleasant Valley and Lake	3.00
1981		3.00
1982		3.25
1983		2.00
1984		1.75
1985		1.75
1980	New Mercer Ditch	5.25
1981		5.00
1982		6.50
1983		6.25
1984		7.25
1985		7.50
1980	Larimer County #2	1.75
1981		2.50
1982		4.00
1983		3.00
1984		3.25
1985		3.50
1980	Arthur Ditch	2.25
1981		2.00
1982		2.00
1983		2.50
1984		5.75
1985		4.50
1976	Button Rock Reservoir	10.50
1977		10.00
1978		9.00
1979		8.25
1980		9.50
1981		8.50
1982		10.25
1983		8.50
1984		8.00

Table 10, continued

Year	Name of Water Company	Price/Af
1976	Handy Ditch Company	11.00
1977		8.50
1978		8.00
1979		8.00
1980		?
1981		7.00
1982		7.50
1983		7.25
1984		7.00
1985		8.00
1981	Rist-Bensen Lake	7.00
1982		6.50
1983		8.50
1984		8.00
1985		8.00
1976	South Lake Ditch Company	11.00
1977		10.50
1978		8.00
1979		7.00
1980		19.50
1981		17.00
1982		13.00
1983		12.50
1984		12.00

Table 11

Acquisitions of Truckee River Rights by Sierra Pacific Power Company

Date	Acre-Feet	Price/Af
1946	189	53.18
1947	458.5	93.00
1951	78	79.97
1952	154.5	78.26
1955	434.7	77.58
1956	236.3	76.44
1957	163.4	73.81
1958	295.8	71.85
1959	1,426.2	114.03
1960	2,431.3	140.35
1961	2,919.1	138.88
1962	1,182.3	137.35
1963	1,451.2	159.32
1964	2,619.1	150.69
1965	2,385.9	131.68
1966	2,059.9	161.29
1967	795.3	156.25
1968	1,933.8	151.52
1969	308.6	142.86
1970	2,081.4	135.14
1971	407.6	128.21
1972	2,036.o	125.00
1973	544.4	116.28
1974	316.8	106.38
1975	580.7	96.15
1976	24.8	90.91
1977	413.0	86.21
1978	756.0	79.37
1979	91.6	71.43
1979-1981	?	85.23-113.64
1982	22.6	86.02
1982	140.0	215.05
1982-1984	?	200 - 225
1984	7.1	211.00

Table 12

Acquisitions of Truckee River Rights by Parties Other Than Sierra Pacific Power Company

Date	Acre-Feet	Price/Af
5/26/82	24.6	1,075.27
6/12/82	1.4	1,182.80
8/30/82	18.2	1,236.56
11/3/82	9.3	2,150.54
11/3/82	6.4	1,236.56
12/23/82	2.0	1,612.90
12/23/82	2.0	940.86
2/17/83	2.0	2,083.33
9/83	11.0	1,562.50
1984	166.0	1,500.00
1984	10.0	2,000.00
3/84	1.94	1,443.00
4/84	3.4	1,400.00
4/84	120.0	1,320.00
5/84	963.0	1,500.00
7/11/84	30.0	1,200.00
1985	200.0	2,000.00
6/85	0.5	1,000.00
7/85	63.1	1,750.00

A water rights appraisal conducted in 1984 identified 52 individual water rights transactions in the Truckee Meadows which took place between 1982 and 1984. Prices ranged from $875/af to $2016/af.

Sierra Pacific claims that the transactions costs for water rights transfers may run between $750 and $5000 per transfer.

Table 13

Prices for Groundwater Rights in the Truckee Basin Area

Date	Area	Quantity	Price/af
1/16/84	South Truckee Meadows	2600	50
1985	Lemmon Valley	?	10,000
1985	Spanish Spring	?	4,000
1985	Fallon	?	300

Table 14

Sales of Water Rights in the Gila Sub-Basin of the Gila-San Francisco Basin

Date	Acre-Feet	Price/Af Received by Seller
2/6/66	116.56	1,300
10/16/68	14.50	1,260
4/8/71	49.88	1,050
4/8/71	38.86	870
4/8/71	48.14	1,030
6/12/71	29.0	920
6/30/71	29.0	720
8/10/71	29.0	730
7/9/74	8.7	1,250
8/11/74	2.9	1,080
3/1/76	81.86	1,130
11/17/77	36.0	1,750
12/77	2.4	1,750
8/2/78	0.64	3,170
8/2/78	1.0	3,170
10/19/78	1.0	3,170
2/5/79	1.0	2,820
2/21/79	1.05	2,820
3/12/79	2.9	970
4/3/79	2.9	1,170
5/29/79	2.9	1,940
11/16/79	2.9	3,390
12/8/80	3.0	2,500
1/23/81	56.84 *	1,960
6/24/81	78.1	1,570
12/28/81	17.4	1,740
11/25/81	2.0	2,270
4/22/82	1.0	1,600
3/16/83	4.8	1,550
9/30/83	2.4	1,770
12/22/83	2.9	1,770
1/18/84	5.8	2,070
3/21/84	2.9	1,720
6/13/84	3.0	1,670
7/2/84	145.0	1,720

Table 14, continued

Date	Acre-Feet	Price/Af Received by Seller
9/10/84	236.64	1,580
9/16/84	3.0	1,670
9/17/84	84.7 *	2,220
10/8/84	3.0	1,670
11/13/84	29.0	1,850
11/20/84	17.4 *	1,285
11/26/84	17.4	2,040
11/27/84	35.7	1,460
11/27/84	58.0	1,350
11/27/84	284.37 *	1,850
11/27/84	87.87 *	2,125
11/27/84	26.97 *	2,150
1985	8.7	1,350
1985	11.6	2,040
1985	14.5	1,300
1/85	58.0	1,200
4/22/85	5.8	1,380
6/85	8.7	1,720

* Both land and water rights were transferred.

Table 15

Sales of Water Rights in the San Francisco Sub-Basin of the Gila-San Francisco Basin

Date	Acre-Feet	Price/Af Received by Seller
5/8/78	6.6	480
7/13/78	35.64	480
9/13/81	3.3	1,030
2/5/82	0.53	3,020
5/21/82	0.53	2,010
6/9/82	0.53	2,010
7/15/82	3.0	1,170
1/6/84	13.04	1,480
5/21/84	2.2	1,200
6/6/84	0.8	1,875
8/10/84	1.1	1,210
8/31/84	3.0	1,170
10/5/84	3.0	1,330
10/31/84	1.49	1,675
10/31/84	1.82	1,650

Table 16

Rentals of Water Rights in the Gila-San Francisco Basin

Date	Sub-Basin	Acre-Feet	Price/Af Received by Seller
12/30/63	San Francisco	39.60	150
10/11/76	Gila	9.57	140
1/8/80	Gila	?	250
8/5/83	Gila	17.4	250
9/30/83	Gila	5.39	110

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Table 17

Sales of Groundwater Rights in Delta Area

Year	Representative Price Range	No. Transactions	A-F Transferred
1980	3,288-1,200	2	6,360
1981	1,750- 909	3	388
1982	638	1	2,000
1984	700	2	400
1985	700	2	?

Table 18

Rental of Delta Co. Water Controlled by Melville Company

Year	Representative Price Range	No. Transactions
1962	34.34	8
1963	59.37	7
1964	50.23	8
1965	41.32	9
1966	24.00	12
1967	43.75-56.25	18
1968	23.53	21
1969	13.89	13
1970	5.26-13.16	26
1971	no rentals recorded	
1972	24.39	8
1973	23.26	7
1974	25.00	10
1975	15.38-28.85	10
1976	27.27	7
1977	42.37	6
1978	31.75	6
1979	28.17	19
1980	6.25	8
1981	8.52	8
1982	7.98	10

There have been no rentals since 1982. In each year in which rentals occurred, approximately 450 acre-feet of Delta Co. water were rented from Melville Co. by irrigators in the areas.

Table 19

Sales of DMAD company Stock, Lower Sevier Basin

Year	Company	Highest Price	Lowest Price	No. Tranactions	Total A-F Transferred
1974	Deseret	323	--	1	30
1976	Abraham	295	--	1	160
1977		636	317	2	?
1977		339	--	1	?
1977		561	339	2	?
1977		541	314	3	?
1978		516	--	1	160
1978		1,094	273	2	538
1978		516	476	3	925
1980*		2,100	--	4	25,007
1981		1,314	--	1	?
1981		1,136	--	1	?
1981		842	--	1	?
1982		1,130	--	1	?
1982		851	567	4	?
1982		788	710	2	?
1983		380	--	1	?
1983		440	343	2	?
1983		406	--	1	?
1983		451	--	1	?
1984		330	--	1	1,500
1985		375	344	2	?
1985		350	333	5	?
1985		500	350	5	?
1985		352	315	5	?

*In 1980 intermountain Power Project purchased approximately twenty percent of each DMAD company's stock for the price per acre-foot indicated.

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